Attention-Driven Sentiment and the Business Cycle*

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Abstract

Using survey data, we show that consumers' economic beliefs are driven by one component, which observationally behaves like "sentiment." Surprisingly, "optimistic" consumers expecting an expansion also consistently predict disinflation, contrasting with professional forecasts. We explain these facts in a New Keynesian model where rationally inattentive consumers face fundamental uncertainty regarding aggregate demand and supply shocks. Optimal information-gathering economizes on information costs but compresses the dimensionality of consumer beliefs. Moreover, because supply-driven recessions are more costly for typical households relying on labor income, more attention is optimally devoted to supply shocks. Consumers' countercyclical perception of inflation is thus (i) *attention-driven*; and (ii) a reflection of a focus on *supply* factors. Consistent with our theoretical mechanisms, we find strong evidence in favor of (i) using measures of attention which exploit methodological features of consumer surveys. Consumers' explicit "reasoning" provides direct evidence in favor of (ii). Finally, consumer beliefs react strongly to identified supply shocks but show only muted reactions to identified demand shocks.

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1 Introduction

Nearly all economic decisions are based on agents' perceptions about the current economy and expectations about future economic outcomes. Nevertheless, the expectation formation process is still not fully understood. Moreover, surveys of consumer beliefs reveal many puzzling features relative to the predictions of workhorse models of expectations. One surprising correlation in surveys is that consumers who believe unemployment will rise also expect *higher* inflation on average (and vice versa). This contrasts with the beliefs of professional forecasters (and the historical comovement between unemployment and inflation in the U.S.).[1]

We show that consumer misperceptions of the typical comovement between inflation and unemployment are part of a broader phenomenon: the correlation structure of consumer beliefs is almost entirely driven by a single factor. This single factor not only explains consumers' macroeconomic forecasts, but also explains backward-looking beliefs about changes in current economic conditions; beliefs about current and future personal financial conditions; and idiosyncratic attitudes towards different types of consumption. This factor seemingly behaves like a traditional "sentiment" factor: at any point in time, a given consumer falls on a spectrum between optimism and pessimism. Optimistic consumers forecast typical expansionary outcomes (such as falling unemployment and improving business conditions), as well as improving personal financial conditions. However, if consumers were simply forecasting "demand-driven" booms and busts, otherwise optimistic individuals should predict inflation will rise. Instead, optimistic consumers expect *lower* inflation.

In order to rationalize these puzzling beliefs and better understand their aggregate implications, we develop a general equilibrium model where agents face information frictions. We embed a Sims (2003) model of rationally inattentive consumers into a two-agent New Keynesian (TANK) framework. Business cycle fluctuations are driven by aggregate discount rate ("demand") and wage cost-push ("supply") shocks. Because information is costly, agents facing information constraints find it optimal to compress information in the manner most informative about their optimal economic actions. We derive conditions under which households relying on labor income will *endogenously* choose to focus their attention towards aggregate supply shocks and away from aggregate demand shocks. This occurs because, under a wide array of assumptions regarding

[1] For detailed evidence of the relationship between inflation and unemployment forecasts of consumers, see the earlier working version of this paper Kamdar (2019) and the references therein.

dynamics and preferences, optimal labor supply is more sensitive to aggregate supply shocks. Intuitively, supply-driven recessions (where output declines and inflation rises) are particularly harmful for these consumers, whereas demand-driven recessions (where output declines but inflation falls) feature a natural hedge.

Our framework explains why consumers act as if they perceive supply shocks as the dominant driver of the business cycle. It is not that consumers misunderstand the aggregate outcomes of demand shocks; rather, consumers rationally choose to learn more precisely about supply shocks because their consequences are acutely painful. This information acquisition strategy explains why consumer beliefs are explained by a lower dimension factor structure than the data. Consumers receive information about optimal economic actions but then update beliefs about all economic outcomes. From this perspective, the observed degree of "optimism" or "pessimism" of a given consumer is simply a function of this optimal information acquisition.

We empirically test the key theoretical mechanisms responsible for consumers' "stagflationary" (countercyclical) perception of inflation. First, we find evidence in favor of *attention-driven* mechanisms. We examine three distinct proxies for consumers' degree of attention. The first utilizes the panel aspect of consumer surveys and compares responses in follow-up relative to initial interviews; all else equal, we expect respondents to dedicate more thought to survey responses in follow-up interviews (Brave et al. 2024). The second exploits recent methodological changes in consumer surveys by comparing phone-based and online interviews; all else equal, we expect interviews conducted by phone to feature more attentive respondents (Hsu 2024). The third examines the degree of rounding in consumers' numeric forecasts; all else equal, we expect respondents who are rounding their forecasts to dedicate less attention to their responses (Binder 2017). Using any of these measures, we find robust evidence that consumers who are less attentive exhibit significantly stronger countercyclical perceptions of inflation.

Next, we provide direct evidence that consumers' countercyclical perception of inflation reflects a focus on *supply-side* factors. We utilize consumers' self-reported "reasoning" for their beliefs regarding business conditions, personal financial conditions, and attitudes towards buying different types of goods. These open-ended responses are classified by interviewers into a highly disaggregated set of approximately six hundred categories. We use these "reasoning" responses in two ways. First, we manually classify responses into ten different broad categories which can be more easily mapped to aggregate supply and demand factors. Second, we take a flexible approach and analyze the factor structure across all six hundred reasoning categories. While the first factor of this analysis essentially replicates our baseline "sentiment" factor, we show that the second factor is a clear measure of the degree of "supply-side" reasoning on the part of consumers. Using either proxy, we find that consumers whose self-reported reasons load more on aggregate supply factors exhibit significantly stronger countercyclical perceptions of inflation.

Finally, we confirm our model prediction that consumer beliefs are more responsive to aggregate supply shocks than to aggregate demand shocks. In particular, we examine the movements in consumer beliefs following oil shocks compared to those following monetary or fiscal shocks. Using Jordà (2005) local projections, we find that following oil shocks from Känzig (2021), consumer beliefs respond strongly and immediately. In contrast, beliefs do not meaningfully react over the course of a year following monetary shocks from Nakamura and Steinsson (2018), exogenous tax shocks from Romer and Romer (2010), or military spending shocks from Ramey and Zubairy (2018).

Our model also shows that these information frictions have important implications for the aggregate dynamics of the economy and for policymakers. As in the TANK literature, the existence of hand-to-mouth agents typically implies that aggregate consumption reacts more strongly to shocks than in the representative agent (RANK) benchmark (Bilbiie 2020). In our model, as is typical in rational inattention models, the active decisions of information-constrained agents on average underreact relative to the full-information benchmark. However, when hand-to-mouth agents make active decisions about labor supply, consumption can actually overreact in response to shocks, implying *additional amplification* relative to a full-information model. We derive precise analytical characterizations of when information frictions either exacerbate or mitigate these TANK amplification channels. Thus, our model implies that aggregate underreaction or overreaction depends on how mistakes due to imperfect information at the household level react with general equilibrium forces. For instance, following a demand-driven expansion, if the optimal full-information response of hand-to-mouth households is to reduce labor supply, then our model implies additional amplification of aggregate output.

Calibrating the model to match important U.S. aggregate business cycle moments and survey data moments, we examine quantitatively how both the aggregate economy and typical beliefs respond to different shocks. Consistent with the intuition described above, the dynamics of inflation beliefs and output beliefs of information-constrained agents are strongly negatively correlated. This is despite the fact that inflation and output are positively correlated in the targeted moments (and thus in the data-generating process of the calibrated model). Additionally, aggregate responses to both demand and supply shocks depend crucially on the ex-ante beliefs of information-constrained households. We compare the dynamics of an economy initially at steady state with a situation where average prior beliefs about a supply-driven recession are two-standard deviations above or below steady state. Output responses to shocks can differ by nearly 50% compared to the model initially at steady state. That is, a shock that boosts output by 1% when average beliefs are at steady state will instead lead to an increase of nearly 1.5% or closer to 0.5%, respectively, depending on whether information-constrained agents believe a supply-driven expansion or supply-driven recession is likely.

We also consider policies aimed at stimulating the economy by manipulating consumer expectations. Typically, such policies seek to induce an increase in consumption through a forward-looking full-information consumption-saving decision. However, we show policies that increase inflation expectations of information-constrained households can easily backfire: these agents erroneously conclude that inflation will be higher due to an impending supply-driven recession. When the optimal response for these agents is to reduce labor supply, the equilibrium effect is a fall in aggregate output. Quantitatively, we find a policy that increases the average inflation beliefs of information-constrained agents by 1.0% implies that average output beliefs of these same agents falls by roughly 1.5%. Because information-constrained agents reduce labor supply and consumption, in equilibrium aggregate output also decreases by approximately 0.9%. Thus, our model formalizes concerns raised in Bachmann et al. (2015) and provides a note of caution for policymakers aiming to manipulate consumer beliefs.

This paper contributes to a number of theoretical and empirical literatures. Most closely related to our rational inattention New Keynesian framework are Maćkowiak and Wiederholt (2009), which studies a rationally inattentive firm choosing prices; Maćkowiak and Wiederholt (2015), which studies general equilibrium business cycle dynamics when households and firms are inattentive; and Afrouzi and Yang (2021), which studies the slope of the New Keynesian Phillips curve as a function of inattention frictions in a dynamic model. Our approach is complementary in using Sims (2003) rational inattention as the foundation for understanding belief formation. We go a step further and provide direct empirical evidence in favor of the information frictions underlying our model mechanisms. Moreover, in our model we characterize the joint dynamics and covariance structure of beliefs and aggregate variables. To do so, we develop novel theoretical results characterizing the dynamic and cross-sectional properties of "surveys" within the model. This allows for a tight link between our empirical and theoretical results.

Our paper is related to a larger literature that seeks to explain beliefs about economic and financial fluctuations (e.g., see Mankiw and Reis 2002, Carroll 2003, Bordalo et al. 2020, Bordalo et al. 2023, Angeletos and La'O 2013, Han 2024). Outside of the rational inattention literature, most closely related is Bhandari et al. (2024), which studies how agents form beliefs about inflation when subject to model misspecification concerns; time-variation in such concerns implies fluctuations in pessimism, which drives biases in consumer beliefs. Our approach is complementary, but in our framework, the centrality of costly information-acquisition has additional implications for heterogeneity across consumer beliefs (absent with representative agents); and explains survey data about *backward-looking* aggregate and personal beliefs (absent in full-information models). Furthermore, we provide direct survey-based evidence that inattention and "supply-side" reasoning are the proximate causes of consumers' stagflationary beliefs. Our results corroborate and provide theoretical justification for the empirical literature that has found that consumers tend to use supply-side reasoning when explaining their views of the economy (e.g., see Shiller 1996, Hajdini et al. 2022, Stantcheva 2024, Andre et al. 2022, Andre et al. 2023, Candia et al. 2020).

Our model also directly extends the theoretical literature on dynamic multivariate rational inattention. We build on the recent theoretical results in Kőszegi and Matějka (2020) (solves a static inattention problem); Maćkowiak et al. (2018) (solves an exogenous scalar inattention problem) and Miao et al. (2022) (solves an exogenous dynamic multivariate rational inattention problem with individual state variable dynamics). Our contribution extends these analytical results to a model in which aggregate dynamics are endogenous and depend in equilibrium on the decisions of other information-constrained agents. While the literature on quantitative rational inattention models has developed techniques for solving these models (such as Maćkowiak and Wiederholt 2015), we derive analytical results regarding the factor structure and dynamics of model-implied surveys; implications regarding the sign of belief covariances; and the conditions under which they differ from the data-generating process in general equilibrium.

Empirically, we add to the literature using survey-based expectations to study how agents form beliefs. Coibion et al. (2018a) provide a history of how survey-based measures of beliefs have been used to document deviations from full-information rational expectations (FIRE).[2] Our empirical contribution to this literature is documenting the

[2]Related research has found that consumers apparently misperceive macroeconomic relationships:

robust low-dimension factor structure of consumer beliefs, and how such a factor structure is responsible for the highly stable but puzzling correlations of consumer inflation and unemployment expectations.

2 Empirical Results

This section presents novel stylized facts about consumer beliefs. We utilize the Michigan Survey of Consumers (MSC) for our main empirical results regarding consumer expectations. The MSC is a long-running consumer survey, which has been conducted monthly since 1978. Typically, the MSC interviews approximately 500 consumers per month. A portion of these respondents are contacted for another survey six months after the initial survey. The MSC asks consumers a range of questions about both aggregate and personal economic conditions that are both forward- and backward-looking.

As a robustness check, we also conduct all our analyses of consumer beliefs using the Federal Reserve Bank of New York's Survey of Consumer Expectations (SCE) in Appendix B. The SCE was only introduced in 2013 but surveys approximately 1,300 consumers per month, conducting follow-up surveys on these consumers every month for one year. The SCE results are qualitatively and quantitatively similar to our baseline MSC analysis.

As a comparison, we use the Survey of Professional Forecasters (SPF). The SPF is a quarterly survey that began in 1968. Each quarter, approximately 40 professional forecasters are asked to make quantitative forecasts about a range of macroeconomic and financial variables. Forecasters are repeatedly surveyed each quarter, though the composition of respondents changes periodically.

The majority of MSC questions only allow for categorical responses. For instance, when asking consumers about their beliefs regarding unemployment, the MSC asks, "How about people out of work during the coming 12 months – do you think that there will be more unemployment than now, about the same, or less?" However, the MSC solicits numerical forecasts when inquiring about consumer beliefs regarding inflation by asking "By about what percent do you expect prices to go (up/down) on the average,

e.g., for U.S. consumers see Dräger et al. (2016), Carvalho and Nechio (2014), Jiang et al. (2024); Ferreira and Pica (2024) uses our methodology and finds similar supply-side views in European consumers. Similar departures from FIRE have been documented when studying the expectations of firms (e.g., see Coibion et al. 2018b, Candia et al. 2021). Consistent with our model, Coibion et al. (2020b) show that an increase in a given firm's inflation expectations is associated with increasingly negative outlooks.

during the next 12 months?" Section 2.1 analyzes the responses to these two questions; Section 2.2 expands our analysis to a broader set of MSC questions.

2.1 Inflation and Unemployment Beliefs

A persistent puzzling feature of consumer beliefs is the relationship between expected inflation and unemployment.[3] This can be seen by estimating the following simple regression in the cross-section of the MSC data:

$$\hat{\pi}^{1Y}_{i,t} = \beta^{+}\hat{u}^{+}_{i,t} + \beta^{-}\hat{u}^{-}_{i,t} + \gamma_t + \varepsilon_{i,t}. \tag{1}$$

The dependent variable $\hat{\pi}^{1Y}_{i,t}$ is the one-year-ahead inflation forecast of consumer i in month t (numerical response). The indicator variables $\hat{u}^{+}_{i,t}$ and $\hat{u}^{-}_{i,t}$, respectively, capture whether the consumer believes unemployment will increase or decrease in the following year (the leave-out group is that unemployment will stay the same).

We estimate (1) in the MSC and compare with a similar specification estimated from the SPF:

$$\hat{\pi}^{1Y}_{i,t} = \beta\hat{u}^{1Y}_{i,t} + \gamma_t + \varepsilon_{i,t}. \tag{2}$$

The dependent variable $\hat{\pi}^{1Y}_{i,t}$ is the 1-year-ahead CPI inflation forecast of respondent i in quarter t. The variable $\hat{u}^{1Y}_{i,t}$ is the 1-year-ahead forecast of the unemployment rate.

Figure 1 examines how the relationship between inflation and unemployment forecasts varies over time. Panel A estimates $\hat{\beta}^{+}, \hat{\beta}^{-}$ from (1) using the MSC data, while Panel B estimates $\hat{\beta}$ from (2) using the SPF data (both over 5-year rolling windows; each specification includes time fixed effects). Panel A shows that across all time periods, consumers who forecast increases in unemployment have higher inflation expectations; the coefficient is positive and significant. Similarly, consumers who believe unemployment will decline have lower inflation forecasts; in all but a handful of periods the coefficient estimate is negative and significant. The magnitudes of the coefficients vary somewhat, increasing in magnitude during periods of high inflation (during the 1980s and in the post-COVID period), but overall the pattern is remarkably stable. We find a stark contrast with professional forecasters: the point estimate in Panel B is negative

[3]See Section 2 and Appendix A of Kamdar (2019) for additional analyses of inflation and unemployment forecasts. For evidence outside of the U.S., see Candia et al. (2020) and Ferreira and Pica (2024); for evidence of firms, see Coibion et al. (2020b) and Candia et al. (2021).

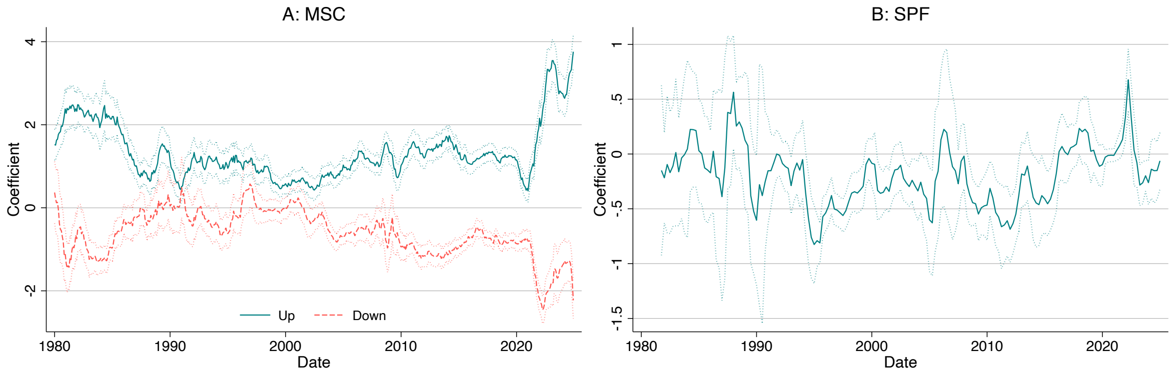

Figure 1: Rolling Inflation/Unemployment Regressions (MSC and SPF)

Notes: 5-year rolling estimates of equations (1) (Panel A) and (2) (Panel B). Each regression includes time fixed effects. Consumer inflation expectations are winsorized at the 1% level. Dotted lines represent 95% confidence intervals.

on average, showing that forecasters who forecast high unemployment tend to believe that inflation will decline. Additionally, the variation across time is significantly larger than that of consumers.

2.2 Factor Structure of Beliefs

In order to understand the drivers of consumer belief correlations, we dive more deeply into additional responses in the MSC. Beyond inflation and unemployment, the MSC asks consumers for their beliefs regarding a wide range of personal and aggregate economic conditions, as well as attitudes towards consumption. To study the factor structure of consumer beliefs, we conduct a multiple correspondence analysis (MCA) across this much wider range of questions. In our baseline MCA, we include all categorical questions the MSC has asked continuously since the early 1980s.[4] This includes forward- and backward-looking questions regarding personal financial circumstances; overall economic conditions; and personal attitudes towards different kinds of consumption.

First, Panel A of Figure 2 reports the estimated loadings of the first component in our baseline MCA. Each element of the x-axis is one of the MSC questions included in our MCA analysis; the caption of Figure 2 includes descriptions of all variables included in the MCA. The points on the corresponding vertical line are the estimated loadings for each question's possible responses (labeled in the figure). The estimated loadings paint

[4]MCA is the categorical analogue of principal component analysis (PCA). The majority of questions in the MSC are categorical; when we include continuous forecasts in the MCA (such as inflation or household income forecasts), we bin responses into terciles.

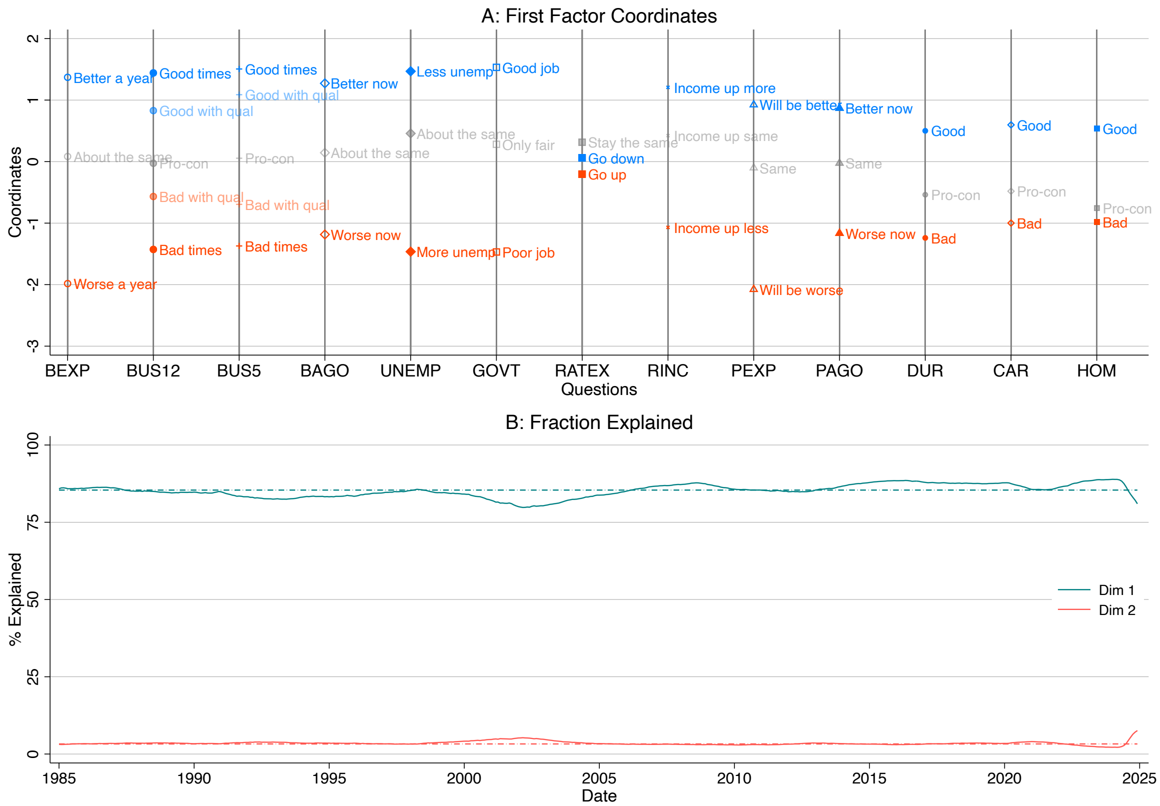

Figure 2: MSC MCA Results

Notes: Panel A reports the loadings of the first component for each categorical response in the baseline MCA, estimated from responses in the MSC. Panel B reports the fraction explained by the first and second components; the dashed lines are the fraction explained when estimated over the entire sample, while the solid lines are the fraction explained when estimated over 5-year rolling windows. Included questions: business conditions in one year relative to now (BEXP), business conditions over the next year (BUS12), business conditions over the next 5 years (BUS5), business conditions better or worse from a year ago (BAGO), unemployment over the next year (UNEMP), attitudes towards government economic policy (GOVT), interest rates over the next year (RATEX), family real income over the next one to two years (RINC), personal financial condition in one year (PEXP), personal financial condition relative to a year ago (PAGO), attitudes towards durable purchases (DUR), attitudes towards auto purchases (CAR), attitudes towards home purchases (HOM).

a very clear picture: responses associated with more traditionally "optimistic" outlooks on either personal or aggregate conditions have high and positive loadings (colored in blue); and vice versa, "pessimistic" responses have negative loadings (colored in red). This is true whether we focus on aggregate forward-looking vs. backward-looking beliefs (e.g., BEXP vs. BAGO); personal or aggregate forecasts (e.g., RINC vs. UNEMP); or across consumption attitudes (e.g., DUR vs. CAR vs. HOM).[5]

[5] Appendix Figure B6 shows that aggregate time-series fluctuations in this first component (averaged over consumers) are highly correlated with many other measures of "sentiment" in the literature.

What is striking is the fraction of variation the first component explains in survey responses. The horizontal dashed lines in Panel B of Figure 2 show that the first component in our baseline MCA explains over 85% of the variation of consumer responses, while the second component explains less than 5 additional percentage points. Panel B also shows that this factor structure is extremely stable over time: the solid lines are the fraction explained when we conduct our MCA over rolling windows (5-year windows; results are robust to other choices). The first component is always responsible for well over 75% of the variation in consumer beliefs, while the second component only adds marginal explanatory power.

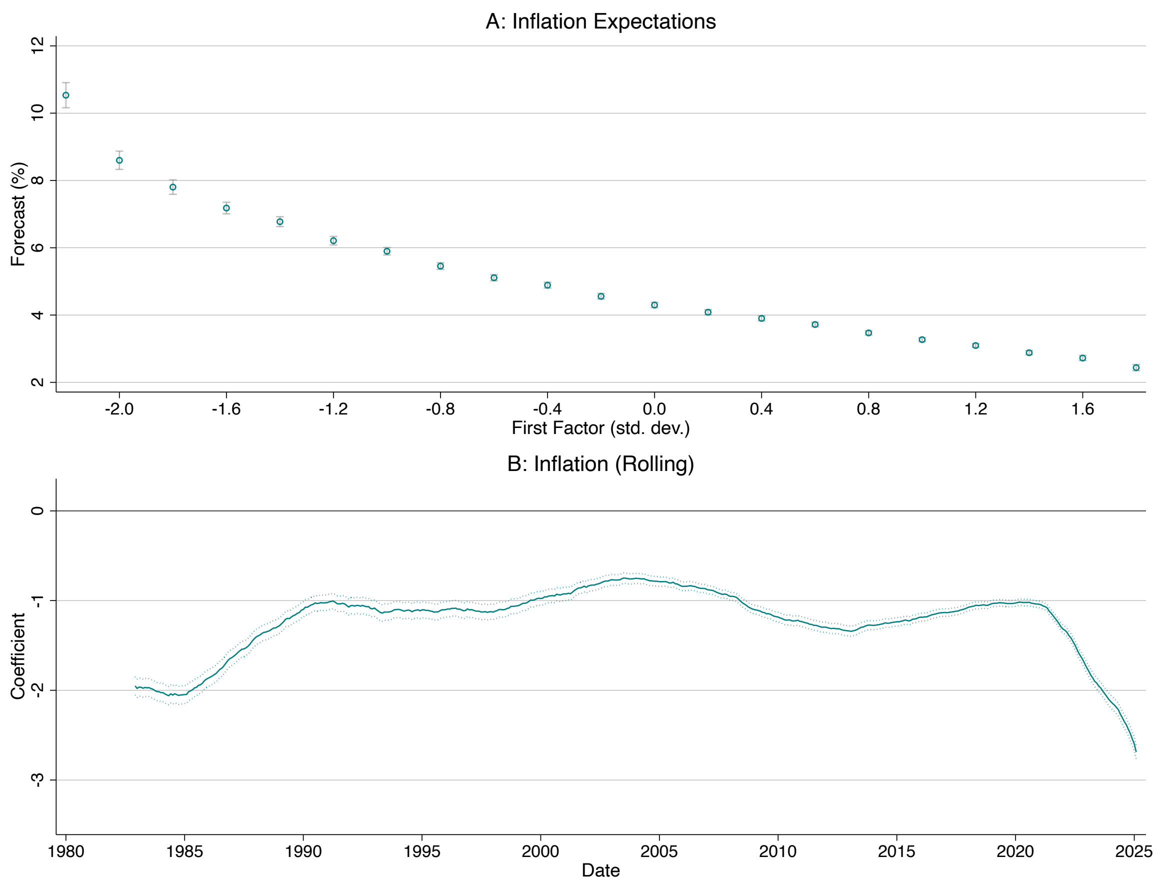

Figure 3: MSC MCA Factor and Inflation Expectations

Notes: Panel A reports an estimated binned scatter plot of the fitted first component $\hat{f}_{i,t}$ (x-axis) and 1-year inflation expectations $\hat{\pi}^{1Y}_{i,t}$ (y-axis). Panel B reports rolling regression estimates of the same set of variables. Dotted/vertical lines represent 95% confidence intervals.

We next use the first component $\hat{f}_{i,t}$ over consumers i and time t to better understand consumers' expectation formation process. Figure 3 shows one of our key findings: the positive correlation between consumer unemployment and inflation forecasts is a reflection of this broader single-dimensional structure of consumer beliefs. Panel A estimates a binned scatter plot of the fitted first component $\hat{f}_{i,t}$ from the baseline MCA and 1-year inflation expectations $\hat{\pi}^{1Y}_{i,t}$. We observe an extremely strong negative relationship between the two variables: a unit (standard deviation) decline in $\hat{f}_{i,t}$ is associated with a 1-3 percentage point increase in 1-year inflation expectations. In other words, otherwise "pessimistic" consumers forecast higher inflation.[6]

Panel B of Figure 3 shows that this relationship between our fitted first component and inflation expectations is robustly negative over the entire sample. We estimate a rolling regression of $\hat{\pi}^{1Y}_{i,t}$ on $\hat{f}_{i,t}$ (5-year windows; results are robust to other choices). The point estimate is always negative and strongly statistically significant. The magnitude increases during periods of high inflation (during the 1980s and in the last few years following COVID). Our results suggest a tight link between consumers' countercyclical perceptions of inflation and our finding that consumer beliefs are single-dimensional.

Figure 4 provides additional evidence pointing towards the importance of our estimated first factor. Our baseline MCA is estimated only from categorical questions which have been consistently asked since 1978. However, the MSC has introduced additional questions which solicit numeric forecasts besides inflation expectations. Figure 4 estimates binned scatter plots for a subset of these questions. As with inflation expectations, we find extremely strong monotonic relationships between our fitted first component $\hat{f}_{i,t}$ and consumers' beliefs across a wide range of outcomes. We find that increases in $\hat{f}_{i,t}$ are associated with large increases in personal income growth expectations (Panel A); large increases in beliefs about the return on investments (Panel B); and large increases in subjective beliefs regarding the adequacy of social security at retirement (Panel C). This last finding is particularly surprising since it involves much longer horizon forecasts compared to the questions which are inputs into our factor analysis.

The bottom panels of Figure 4 show additional evidence that consumers' countercyclical inflation perceptions are tightly linked to our estimated first factor. As with 1-year inflation expectations, we find extremely strong negative relationships between $\hat{f}_{i,t}$ and 5-year inflation expectations (Panel D) or gas price expectations over the next year of five years (Panels E and F).

Table 1 shows that the factor structure of consumer beliefs is not driven by our

[6] Appendix Figure B2 shows the negative relationship is robust across consumer demographics.

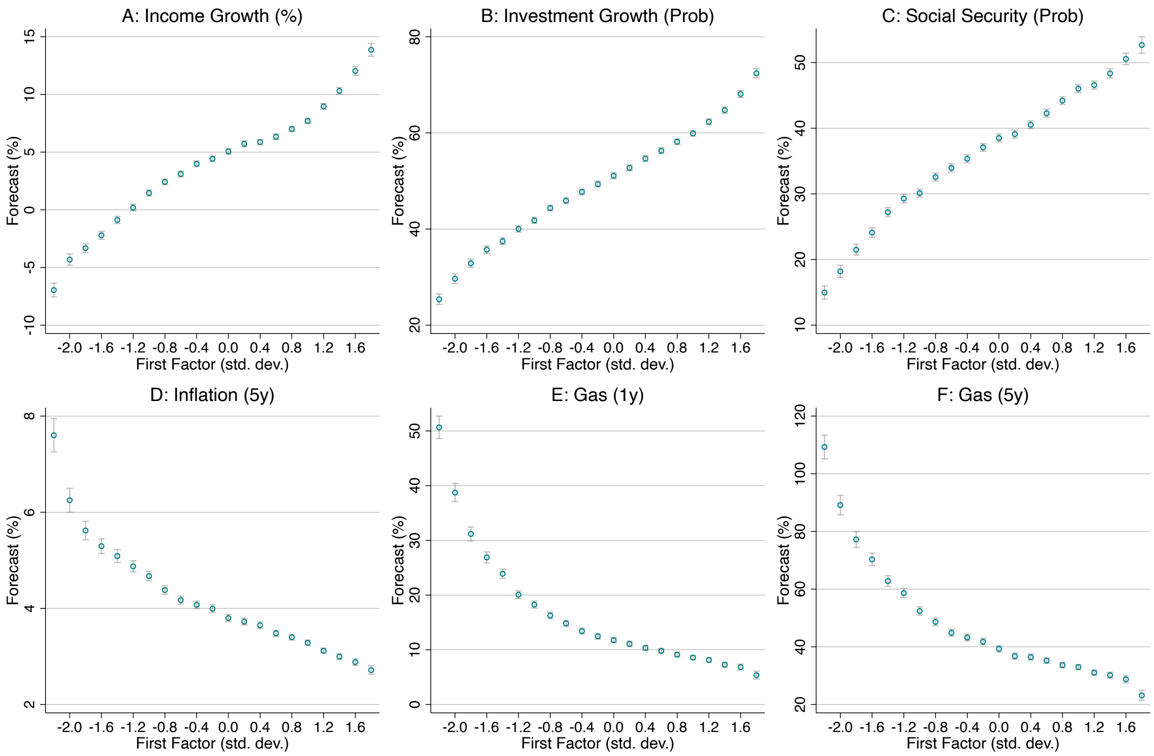

Figure 4: MSC MCA Factor and Additional Expectations

Notes: estimated binned scatter plots of the fitted first component $\hat{f}_{i,t}$ (x-axis) and other numeric forecasts from the MSC. Panel A: personal income growth expectations (percent). Panel B: positive investment returns (probability). Panel C: adequate social security in retirement (probability). Panel D: 5-year inflation expectations (percent). Panel E: 1-year gas price expectations (percent). Panel F: 5-year gas price expectations (percent). Vertical lines represent 95% confidence intervals.

particular choice of questions to include in the MCA. Column (1) of Panel A summarizes the results of our baseline MCA, while columns (2) through (8) include different sets of questions and report the fraction explained by the first two components. We also report the correlation of the fitted first component in these alternative MCAs with our baseline. We first directly include inflation expectations in our MCA: column (2) includes 1-year inflation expectations, while column (3) includes 5-year inflation expectations as well as 1- and 5-year gas price expectations.[7] Additionally, consistent with Figure 3, in Appendix Figure B1 we show that higher inflation expectations are associated with negative estimated loadings on the first factor. Column (4) includes additional questions

[7]We bin numerical responses in order to include these questions in our MCA. In order to mimic the typical MSC categories, we bin numerical responses into terciles, but results are robust to alternative choices.

Table 1: MSC MCA Summary

Panel A:	Baseline	Prices/Other Questions			Aggregate/Personal Only			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dim 1 %	85.4	81.5	77.8	76.6	88.1	79.1	68.3	82.6
Dim 2 %	3.3	4.7	4.6	6.1	3.0	4.5	13.1	14.3
Base Corr.		0.992	0.976	0.942	0.931	0.907	0.743	0.587
Obs.	242,721	212,205	93,333	86,628	251,943	101,720	257,858	282,714
Start Date	1978	1978	1983	2005	1978	1983	1978	1978
Panel B:	Income		Home Value		Investment		Education	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dim 1 %	84.2	84.9	84.9	83.0	84.1	82.3	86.3	84.8
Dim 2 %	3.8	3.1	3.6	3.4	3.1	3.8	3.4	3.0
Base Corr.	0.999	0.999	0.998	0.999	0.999	0.998	0.999	0.999
Obs.	29,617	54,346	13,864	17,243	13,802	17,464	64,496	56,061
Start Date	1979	1979	1990	1990	1990	1990	1978	1978

Notes: Panel A reports MCA results for various questions: (1) baseline; (2) adds numerical income and inflation expectations; (3) adds 5-year inflation expectations and 1/5-year gas price expectations; (4) adds questions related to probability of job loss, income or stock gains, and retirement; (5) aggregate questions only; (6) aggregate only, including gas price questions; (7) personal questions only; (8) personal only, excluding consumption questions; numerical questions are binned into terciles. Panel B reports MCA results using the baseline set of questions across different respondent subgroups: bottom/top quintiles of income groups (1 and 2); bottom/top quintiles of home value (3 and 4); bottom/top quintiles of stock holdings (5 and 6); and no college/college degree (7 and 8). The "baseline correlation" is the correlation of fitted first components of a given MCA and first component from the baseline MCA.

introduced in the 2000s, related to the probability of income gains, job losses, stock returns, and the chances of enjoying a comfortable retirement. In all cases, the first component explains over 75% of the variation, and is highly correlated with the fitted first component from our baseline specification. We also find similar patterns when only including aggregate questions (columns 5 and 6), or only including questions related to personal conditions (columns 7 and 8).

Panel B shows that the single-dimensional factor structure is robust across demographic groups as well. Columns (1) and (2) compare the bottom and top quintiles of the income distribution. Columns (3) and (4) compare the bottom and top quintiles of home values. Columns (5) and (6) compare the bottom and top quintiles of stock holdings. Columns (7) and (8) compare consumers with no college education and those with a college degree. Across all groups, the estimated MCAs are highly similar, both in terms of fraction explained and the correlation with our baseline MCA (which is well above 99%).

In the Appendix, we show that the factor structure of consumer beliefs is not unique to the MSC. Appendix Figure B3 shows that very similar results hold in the SCE. Despite the significantly shorter time period and the dearth of questions related to personal consumption attitudes, we still find that a single component explains over 60% of the variation in responses (Appendix Figures B3 and B4); and that the fitted first component exhibits an extremely strong negative relationship with different measures of inflation expectations (Appendix Figure B5). Like in the MSC, we find that the factor structure is also stable over different demographic groups in the SCE (Appendix Table B1).

In comparison, we conduct similar factor analyses of professional forecasters using the SPF. Appendix Table B2 reports a PCA across a wide range of macroeconomic questions in the SPF. There are two major differences from our results using consumer surveys: (i) the first component loading on inflation and unemployment are consistent with demand-driven business cycle fluctuations; and (ii) the first component only explains about 35% of the variation in responses, and the second, third, and fourth components explain over 10 percentage points of variation each.[8]

Taking stock, we find the correlation structure of consumer unemployment and inflation expectations in Section 2.1 is part of a broader phenomenon: consumer beliefs about a wide range of economic and financial conditions are explained by a single component (unlike professionals' beliefs). Estimated loadings show this component acts like an apparent "sentiment" measure that loads negatively on high inflation beliefs.

3 Model

We now develop a tractable general equilibrium model to rationalize the disconnect between survey-based beliefs and the aggregate fluctuations in economic activity and inflation. Our framework builds on standard two-agent New Keynesian (TANK) models (e.g., Bilbiie 2020, Mankiw 2000). Differentiated firms face pricing frictions and produce using labor supplied by households. One set of households owns the firms and has access to financial markets ("capitalists"), while the other set does not and therefore must consume all income every period ("hand-to-mouth"). Our point of departure is to introduce information frictions as in the rational inattention literature (Sims 2003).

The purpose of our model is two-fold. First, we wish to understand what (if any) conditions there are in which information-constrained agents form beliefs that are consistent with the empirical facts from Section 2. Second, we use our model to explore the aggregate implications of belief frictions. An important question is therefore: which agents are subject to information frictions? Put another way, who in the model is mapped to

[8] Appendix Table B3 also conducts a "pseudo-MCA" using the SPF data by transforming the quantitative responses into quintiles; results are similar to the estimated PCA.

MSC respondents, and who is more similar to SPF respondents? Our baseline assumption is that only financially constrained consumers are subject to information frictions.[9] Of course, not all respondents in the MSC are financially constrained, so in Appendix F we study a version of our model where both capitalists and firms may also be subject to information frictions. While this introduces unnecessary complexities into the dynamics of the model, we show that the precise choice of which agents face information frictions does not significantly change how the model can match our survey results. In what follows, we compare and contrast our baseline findings with those in Appendix F.

Households: A continuum of households are indexed by $j \in [0,1]$. For $j \in (\lambda, 1]$, households are "capitalists". Capitalist households are standard: they own the firms and choose consumption, labor, and savings in order to maximize lifetime expected utility. We assume these households form expectations with perfect information under rational expectations, denoted by the FIRE operator $\mathbb{E}_t$. The capitalist households are representative; denoting the representative capitalist household with superscript '$\mathcal{K}$', the lifetime discounted expected utility is given by

$$\mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t u\left(C_t^{\mathcal{K}}, N_t^{\mathcal{K}}; \mathbf{Z}_t\right), \tag{3}$$

and per-period budget constraints are given by

$$C_t^{\mathcal{K}} + Q_t B_t^{\mathcal{K}} = B_{t-1}^{\mathcal{K}} + W_t N_t^{\mathcal{K}} + T_t^{\mathcal{K}}. \tag{4}$$

The $\mathcal{K}$ households choose consumption and labor $C_t^{\mathcal{K}}, N_t^{\mathcal{K}}$ and earn the real wage W_t; and choose bond holdings $B_t^{\mathcal{K}}$ with (real) price denoted by Q_t. The final term $T_t^{\mathcal{K}}$ in the budget constraint (4) are transfers from the government and firms. The vector $\mathbf{Z}_t$ collects aggregate preference shifters (described below). In equilibrium, the *representative* $\mathcal{K}$ *household problem* is standard: choose $\left\{C_t^{\mathcal{K}}, N_t^{\mathcal{K}}, B_t^{\mathcal{K}}\right\}_{t=0}^{\infty}$ in order to maximize (3) subject to the sequence of budget constraints (4).

The households $j \in [0, \lambda]$ are "hand-to-mouth" ($\mathcal{H}$), choosing labor and consumption and facing the same per-period utility function $u\left(C_t^{\mathcal{H},j}, N_t^{\mathcal{H},j}; \mathbf{Z}_t\right)$. However, they differ from the representative $\mathcal{K}$ households along two dimensions. First, these agents cannot access financial markets (cannot borrow nor own firms); in addition, they are fully

[9] This is also consistent with the empirical literature showing financial constraints and cognitive capacity are correlated (e.g., Mani et al. 2013, Sergeyev et al. 2024).

myopic ($\beta^{\mathcal{H}} = 0$), and therefore consume all income every period.[10] Thus, for household $j \in [0, \lambda]$, the household budget constraint is given by

$$C_t^{\mathcal{H},j} = W_t N_t^{\mathcal{H},j} + T_t^{\mathcal{H}}. \tag{5}$$

The real wage W_t is the same for all households, but lump-sum transfers $T_t^{\mathcal{H}}$ will generally differ from $\mathcal{K}$ households.

The second difference is that $\mathcal{H}$ households face information frictions when forming beliefs. $\mathcal{H}$ households cannot observe (current or past) variables perfectly. Instead, $\mathcal{H}$ households collect noisy signals $\mathbf{s}_t^j$, but more precise signals are more costly. Expectations of household j are formed with respect to the information set $\{\mathbf{s}_\tau^j\}_{\tau \leq t} \equiv \mathcal{I}_t^j$ (the history of signals). We denote the expectation operator of household j by $E_t^j \neq \mathbb{E}_t$ (which differs from FIRE).

Because of information frictions, $\mathcal{H}$ households will only observe wages W_t and transfers $T_t^{\mathcal{H}}$ with noise. In order to ensure that the budget constraint (5) binds, we assume that each $\mathcal{H}$ household $j \in [0, \lambda]$ consists of workers, shoppers, and a "head of household." At the beginning of the period, the head of household j collects information and forms beliefs about the aggregate economy, which we interpret as "forecasts." The head of household then decides how much labor is supplied by the worker. The shopper receives all labor and transfer income and consumes according to (5). Thus, while the budget constraint binds with equality in each period, no new information is revealed to the head of household at the end of each period. This implies that labor supply $N_t^{\mathcal{H},j}$ is the active choice of the $\mathcal{H}$ households, while consumption $C_t^{\mathcal{H},j}$ acts as a residual.[11] With this assumption, the $\mathcal{H}$ household payoff function can be written

$$E_t^j \, U\left(N_t^{\mathcal{H},j}; \mathbf{X}_t\right) - \mu I\left(\mathbf{X}_t; \mathcal{I}_t^j \,\middle|\, \mathcal{I}_{t-1}^j\right). \tag{6}$$

Concentrated utility is defined by $U\left(N_t^{\mathcal{H},j}; \mathbf{X}_t\right) = u\left(W_t N_t^{\mathcal{H},j} + T_t^{\mathcal{H}}, N_t^{\mathcal{H},j}; \mathbf{X}_t\right)$ and depends on the labor choice $N_t^{\mathcal{H},j}$ as well as $\mathbf{X}_t$, the set of all aggregate variables relevant

[10]Under full information, assuming myopia and an inability to borrow is equivalent to assuming an inability to borrow or save. However, information frictions may implicitly introduce a degree of dynamic consideration into the problem of the $\mathcal{H}$ households. We return to this point in Section 3.1.

[11]For many financially constrained households, the assumption that labor supply is "actively" chosen and then consumption is determined "passively" by labor income is a natural one. However, in Appendix E we study the alternative where consumption is actively chosen, and show that this does not qualitatively change our findings. Additionally, we show that under a wide array of parameterizations, information-constrained households prefer *a priori* to actively choose labor supply.

for the $\mathcal{H}$ household decisions. The vector $\mathbf{X}_t$ will contain the preference shifters $\mathbf{Z}_t$ and any other state variables or shocks that affect the real wage W_t and transfers $T_t^{\mathcal{H}}$. Both the set and distribution of variables $\mathbf{X}_t$ are endogenous but taken as given by households. The final term captures information costs. Information costs depend on $I\left(\mathbf{X}_t; \mathcal{I}_t^j \middle| \mathcal{I}_{t-1}^j\right)$, the conditional Shannon mutual information between the variables $\mathbf{X}_t$ and the signals in the current information set $\mathcal{I}_t^j$, given the previous history of signals in $\mathcal{I}_{t-1}^j$. We assume information costs are a linear function of conditional Shannon mutual information; the coefficient μ therefore captures how costly is an additional "unit" of information. In equilibrium, the *hand-to-mouth household j problem* is to maximize (6) by choosing both a distribution of signals $\mathbf{s}_t^j$ and labor supply $N_t^{\mathcal{H},j}$, taking the information set $\mathcal{I}_{t-1}^j$ as given.

Firms: Differentiated intermediate goods are produced by a continuum of monopolistically competitive firms $i \in [0,1]$ producing output $Y_t(i)$. The final consumption basket is produced by a representative firm in a perfectly competitive retail sector, which combines differentiated products using the usual constant elasticity of substitution. This implies that the consumption basket C_t^j for household j is given by $C_t^j = \left[\int_0^1 C_t^j(i)^{(\epsilon-1)/\epsilon}\,\mathrm{d}i\right]^{\epsilon/(\epsilon-1)}$. Demand for good i from household j is therefore $C_t^j(i) = (P_t(i)/P_t)^{-\epsilon} C_t^j$, where $P_t(i)$ is the price chosen by firm i and $P_t \equiv \left[\int_0^1 P_t(i)^{1-\epsilon}\,\mathrm{d}i\right]^{1/(1-\epsilon)}$ is the price index. Aggregate demand for good i is therefore given by $C_t(i) = \left(\frac{P_t(i)}{P_t}\right)^{-\epsilon} C_t$, where C_t is aggregate consumption.

Intermediate firms produce using a linear technology in labor $Y_t(i) = N_t(i)$, which they hire at the real wage W_t. Firms choose prices in order to maximize discounted expected profits, but face Calvo pricing frictions: a firm cannot update its price each period with probability θ (iid across time and firms). We assume intermediate firms are owned by the $\mathcal{K}$ households. When updating prices $P_t(i)$, lifetime expected discounted profits are given by

$$\mathbb{E}_t \sum_{k=0}^{\infty} \theta^k Q_{t,t+k}^{\mathcal{K}} D_{t+k|t}(i), \tag{7}$$

where real profits of firm i are $D_{t+k|t}(i) = (1+\tau^{\mathcal{K}})\,(P_t(i)/P_{t+k})\,Y_{t+k}(i) - W_{t+k}N_{t+k}(i) - T_{t+k}^F$ if the firm is unable to update its price from $P_t(i)$ at time $t+k$. Thus, profits are discounted by θ^k, the probability of being unable to change prices from $P_t(i)$ at time $t+k$. The term $Q_{t,t+k}^{\mathcal{K}}$ is the real SDF of the $\mathcal{K}$ households (where expectations are taken under FIRE, consistent with $\mathcal{K}$ households). Profits include a production subsidy

$\tau^{\mathcal{K}}$, financed by lump-sum taxes T_t^F. In equilibrium, the *firm i problem* when updating prices (with probability $1-\theta$) is to choose $P_t(i)$ in order to maximize (7), subject to the production function and the sequence of CES demand constraints.

Government: The fiscal authority sets an optimal production subsidy $\tau^{\mathcal{K}} = 1/(\epsilon - 1)$, implying markups are zero in steady state. This subsidy is self-financed with firm lump-sum taxes: $T_t^F = \int_0^1 \tau^{\mathcal{K}} \left(P_t(i)/P_t\right) Y_t(i)\,\mathrm{d}i$. The fiscal authority also taxes the profits of $\mathcal{K}$ households at a rate τ^D and redistributes to the $\mathcal{H}$ households. Aggregate profits $D_t = \int_0^1 D_t(i)\,\mathrm{d}i$ are received each period by the $\mathcal{K}$ households, so a given $\mathcal{K}$ household pays a tax $\tau^D D_t/(1-\lambda)$, while a given $\mathcal{H}$ household receives $\tau^D D_t/\lambda$. The central bank chooses the nominal interest rate $i_t \equiv -\log Q_t^{(nom)}$, where $Q_t^{(nom)}$ is the price of a nominal one-period bond.

Aggregate Shocks: Per-period utility is separable in consumption and labor and depends on a vector of aggregate shocks $\mathbf{Z}_t \equiv (\Psi_t, \Gamma_t)$:

$$u(C_t^j, N_t^j; \mathbf{Z}_t) = \Psi_t \left[\frac{\left(C_t^j\right)^{1-\varsigma} - 1}{1-\varsigma} - \Gamma_t \frac{\left(N_t^j\right)^{1+\varphi}}{1+\varphi} \right]. \tag{8}$$

Thus, Ψ_t is an aggregate discount factor shock and Γ_t is an aggregate disutility of labor shock, both of which affect all households.

We assume this set of aggregate shocks in order to parsimoniously map our model to the empirical results in Section 2. Our choices are driven by two main considerations. First, we want sets of shocks that may have different qualitative effects on output and inflation. As we will show, in equilibrium Ψ_t will act as an "aggregate demand" shock, while Γ_t will act as a wage cost-push "aggregate supply" shock. Second, we abstract from more standard technology shocks so that we can work directly with output rather than output gaps.[12]

Aggregation and Linearization: Aggregating across firms and $\mathcal{K}$ households is standard. However, while the $\mathcal{H}$ households are identical in terms of preferences, their expectations may differ, and so their consumption and labor choices may differ as well. Define the average consumption and labor supply of the $\mathcal{H}$ households as $C_t^{\mathcal{H}} \equiv \frac{1}{\lambda}\int_0^\lambda C_t^{\mathcal{H},j}\,\mathrm{d}j$ and $N_t^{\mathcal{H}} \equiv \frac{1}{\lambda}\int_0^\lambda N_t^{\mathcal{H},j}\,\mathrm{d}j$. Aggregate consumption and labor supply are thus $C_t = \lambda C_t^{\mathcal{H}} + (1-\lambda)C_t^{\mathcal{K}}$ and $N_t = \lambda N_t^{\mathcal{H}} + (1-\lambda)N_t^{\mathcal{K}}$.

We approximate the model around the zero-inflation steady state. Where applica-

[12]In Appendix F, we consider the case where firms are subject to aggregate technology shocks.

ble, lower case variables denote log-deviations from steady state values: $X_t = \bar{X} e^{x_t}$. For profits that are zero in steady state, define $d_t = D_t / \bar{Y}$. For now, we take as given the average labor choice of $\mathcal{H}$ households, which allows us to defer solving the $\mathcal{H}$ information problem. Given $N_t^{\mathcal{H}}$, dynamics in our model mimic standard TANK models (see Appendix D for additional derivations).

Because the optimal production subsidy ensures profits are zero in steady state, consumption and labor supply decisions of $\mathcal{H}$ and $\mathcal{K}$ households will also be equal in steady state. Thus, the log-linearized aggregate consumption and labor supply equations are simply $c_t = \lambda c_t^{\mathcal{H}} + (1-\lambda) c_t^{\mathcal{K}}$ and $n_t = \lambda n_t^{\mathcal{H}} + (1-\lambda) n_t^{\mathcal{K}}$. Market clearing in goods markets and production also implies that $y_t = c_t = n_t$ (since price dispersion has no first-order effects on aggregate output). Aggregate profits are given by $d_t = -w_t$. The representative $\mathcal{K}$ intratemporal and intertemporal optimality conditions take the usual log-linearized form

$$w_t = \gamma_t + \varsigma c_t^{\mathcal{K}} + \varphi n_t^{\mathcal{K}}, \;\; \mathbb{E}_t \Delta c_{t+1}^{\mathcal{K}} = \varsigma^{-1} \left(i_t - \mathbb{E}_t \pi_{t+1} - v_t \right), \tag{9}$$

where $v_t = -\mathbb{E}_t \Delta \psi_{t+1}$ and the policy rate i_t is measured as deviations from the long-run rate $i^* \equiv -\log \beta$. The aggregate discount factor and wage cost-push shocks follow independent AR(1) processes $v_t = \rho_v v_{t-1} + \varepsilon_{v,t}$ and $\gamma_t = \rho_\gamma \gamma_{t-1} + \varepsilon_{\gamma,t}$, where $\varepsilon_{v,t} \sim \mathcal{N}(0, \sigma_v^2)$ and $\varepsilon_{\gamma,t} \sim \mathcal{N}\left(0, \sigma_\gamma^2\right)$ are iid Gaussian innovations.

Log-linearized firm optimality conditions imply a New Keynesian Phillips curve

$$\pi_t = \kappa_w w_t + \beta \mathbb{E}_t \pi_{t+1}, \tag{10}$$

where $\kappa_w \equiv \frac{(1-\beta\theta)(1-\theta)}{\theta}$ is the slope of the Phillips curve with respect to marginal cost (which in our model is given by the real wage).

From the $\mathcal{H}$ budget constraint, we have that $c_t^{\mathcal{H}} = n_t^{\mathcal{H}} + \left(1 - \tau^D/\lambda\right) w_t$ (where the term $-\tau^D w_t/\lambda$ captures any fiscal redistribution and follows because aggregate profits are inversely related to the wage). Under full information, the $\mathcal{H}$ and $\mathcal{K}$ intratemporal optimality conditions are the same; $\mathcal{H}$ optimal decisions are given by

$$(\varsigma + \varphi) n_t^{\mathcal{H},*} = \chi_n w_t - \gamma_t, \;\; (\varsigma + \varphi) c_t^{\mathcal{H},*} = \chi_c w_t - \gamma_t, \tag{11}$$

$$\text{where} \quad \chi_n \equiv 1 - \varsigma \left(1 - \tau^D/\lambda\right), \;\; \chi_c \equiv 1 + \varphi \left(1 - \tau^D/\lambda\right). \tag{12}$$

Our model will feature similar departures from standard RANK models as in Bilbiie

(2020). Indeed, under full information our model only differs in terms of the shocks we consider; in particular, the role played by the parameter χ_c is identical in terms of the dynamics of output to a demand shock. However, because of information frictions, in general household j will choose $n_t^{\mathcal{H},j} \neq n_t^{\mathcal{H},*}$; moreover, average labor supply in equilibrium will also differ from the full-information case $n_t^{\mathcal{H}} \neq n_t^{\mathcal{H},*}$. Thus, $w_t \neq \gamma_t + (\varsigma + \varphi)y_t$ (as would be the case under full information). Instead, combining market clearing conditions with $\mathcal{K}$ intratemporal optimality conditions and the $\mathcal{H}$ budget constraint, we have

$$w_t = \frac{(1-\lambda)\gamma_t + (\varsigma + \varphi)(y_t - \lambda n_t^{\mathcal{H}})}{1 - \lambda \chi_n} \equiv \omega_\gamma \gamma_t + \omega_y y_t + \omega_n n_t^{\mathcal{H}}. \tag{13}$$

Thus, the real wage (and therefore firm marginal costs) will be affected by the information frictions faced by $\mathcal{H}$ households (since equilibrium wages depend directly on the labor supply decisions of all households). Combining equilibrium $\mathcal{H}$ consumption with the $\mathcal{K}$ intertemporal choices, aggregate output evolves according to

$$\mathbb{E}_t \Delta y_{t+1} = \frac{(1-\lambda)\varsigma^{-1}}{1 - \lambda\zeta_y} \left(i_t - \mathbb{E}_t \pi_{t+1} - v_t\right) + \frac{\lambda \zeta_\gamma}{1 - \lambda \zeta_y} \mathbb{E}_t \Delta \gamma_{t+1} + \frac{\lambda \zeta_n}{1 - \lambda \zeta_y} \mathbb{E}_t \Delta n_{t+1}^{\mathcal{H}}, \tag{14}$$

where $\zeta_\gamma \equiv \varsigma^{-1}(1-\chi_n)\omega_\gamma$, $\zeta_y \equiv \varsigma^{-1}(1-\chi_n)\omega_y$, $\zeta_\gamma \equiv 1 + \varsigma^{-1}(1-\chi_n)\omega_n$, and the Phillips curve can be written

$$\pi_t = \kappa_w \left[\omega_\gamma \gamma_t + \omega_y y_t + \omega_n n_t^{\mathcal{H}}\right] + \beta \mathbb{E}_t \pi_{t+1}. \tag{15}$$

Hence, aggregate dynamics will depart from RANK for similar reasons as in TANK models. For instance, the output elasticity with respect to the interest rate is no longer given by the intertemporal elasticity of substitution; and wage cost-push shocks appear directly in (14). But aggregate dynamics will also depend on the dynamics of the labor supply decisions of information-constrained households. To understand the differences from full-information TANK models, we next derive how information-constrained agents learn about the economy.

3.1 Belief Factor Structure: General Results

Before solving for the equilibrium dynamics of our specific model, this section studies the belief structure of our model's inattentive agents. Taking as given the aggregate dynamics of the model, we characterize how household beliefs are formed under very general conditions. This allows us to illuminate which results regarding beliefs will hold under alternative models (such as different shocks or different choice sets of households); and vice versa, which elements of our model are necessary for matching the facts we document in Section 2.

Suppose that the equilibrium aggregate dynamics of the model can be written

$$\begin{bmatrix} \mathbf{x}_t \\ \mathbb{E}_t \mathbf{y}_{t+1} \end{bmatrix} = \tilde{\mathbf{A}} \begin{bmatrix} \mathbf{x}_{t-1} \\ \mathbf{y}_t \end{bmatrix} + \tilde{\mathbf{C}} \boldsymbol{\varepsilon}_t, \quad \boldsymbol{\varepsilon}_t \sim \mathcal{N}(\mathbf{0}, \mathbf{I}). \tag{16}$$

The vector $\mathbf{x}_t$ collects all predetermined (state) variables, $\mathbf{y}_t$ collects all nonpredetermined (jump) variables, and $\boldsymbol{\varepsilon}_t$ collects all innovation (shock) variables. Gaussian shocks ensure that the information problem is tractable (but assuming independence is without loss of generality). We assume the usual Blanchard and Kahn (1980) determinacy conditions hold, so there exists a unique linear rational expectations equilibrium.

The dynamics matrices $\tilde{\mathbf{A}}$ and $\tilde{\mathbf{C}}$ are endogenous, as are the set of state variables; in equilibrium, these objects will depend on how inattentive households collect information (we return to this point below). Nevertheless, all agents take these dynamics as given. This includes the information-constrained households: while they do not observe variables perfectly, they fully understand the dynamics of the model conditional on the realization of the state and shocks.

We maintain the following assumptions: an inattentive agent j is (i) "hand-to-mouth" (i.e., there are no idiosyncratic state variables such as savings); and (ii) myopic (i.e., discount factor $\beta^j = 0$). We solve the information problem using a second-order approximation of an arbitrary per-period utility function that may depend directly on state variables $\mathbf{x}_t, \mathbf{x}_{t-1}$, jump variables $\mathbf{y}_t$, and realizations of the shock $\boldsymbol{\varepsilon}_t$. We further allow for a more generic set of actions $\mathbf{a}_t^j$ (and where the set of actions has already concentrated out any constraints). The following Proposition characterizes the dynamics of beliefs and actions.

Proposition 1 (Optimal Information, General Dynamics)**.** *Suppose equilibrium dynamics are described by equations (16). Then the information costs of a myopic agent j are given by $\mu I\left(\mathbf{X}_t; \mathcal{I}_t^j \middle| \mathcal{I}_{t-1}^j\right)$, where the vector $\mathbf{X}_t$ satisfies*

$$\begin{bmatrix} \mathbf{x}_{t-1} \\ \boldsymbol{\varepsilon}_t \end{bmatrix} \equiv \mathbf{X}_t = \begin{bmatrix} \mathbf{A}_x & \mathbf{C}_x \\ \mathbf{0} & \mathbf{0} \end{bmatrix} \mathbf{X}_{t-1} + \begin{bmatrix} \mathbf{0} \\ \mathbf{I} \end{bmatrix} \boldsymbol{\varepsilon}_t \equiv \mathbf{A}\mathbf{X}_{t-1} + \mathbf{C}\boldsymbol{\varepsilon}_t, \tag{17}$$

and matrices $\mathbf{A}_x, \mathbf{C}_x$ are defined in (A1). The quadratic utility approximation

$$U\left(\mathbf{x}_t, \mathbf{x}_{t-1}, \mathbf{y}_t, \boldsymbol{\varepsilon}_t; \mathbf{a}_t^j\right) \approx -\left(\mathbf{a}_t^j\right)^\top \mathbf{B}_{aa}\mathbf{a}_t^j + \mathbf{X}_t^\top \mathbf{B}_{xa}\mathbf{a}_t^j \tag{18}$$

implies the optimal signal structure is a (time-invariant) linear Gaussian process:

$$\mathbf{s}_t^j = \mathbf{H}_x\mathbf{x}_{t-1} + \mathbf{H}_\epsilon\boldsymbol{\varepsilon}_t + \boldsymbol{\eta}_t^j \equiv \mathbf{H}\mathbf{X}_t + \boldsymbol{\eta}_t^j, \quad \boldsymbol{\eta}_t^j \sim \mathcal{N}\left(\mathbf{0}, \boldsymbol{\Sigma}_\eta\right), \tag{19}$$

with associated prior and posterior covariances and Kalman gain matrix, respectively, denoted by $\boldsymbol{\Sigma}_{1|0} \equiv Var_t\left[\mathbf{X}_t | \mathcal{I}_{t-1}^j\right]$ and $\boldsymbol{\Sigma}_{1|1} \equiv Var_t\left[\mathbf{X}_t | \mathcal{I}_t^j\right]$, and $\mathbf{K}$, jointly solving the Kalman filter equations (A2). Posterior means evolve according to

$$\hat{\mathbf{X}}_t^j \equiv E_t\left[\mathbf{X}_t | \mathcal{I}_t^j\right] = \mathbf{K}\mathbf{H}\mathbf{X}_t + \left(\mathbf{I} - \mathbf{K}\mathbf{H}\right)\mathbf{A}\hat{\mathbf{X}}_{t-1}^j + \mathbf{K}\boldsymbol{\eta}_t^j, \tag{20}$$

and prior means are given by $\tilde{\mathbf{X}}_t^j \equiv E_t\left[\mathbf{X}_t | \mathcal{I}_{t-1}^j\right] = \mathbf{A}\hat{\mathbf{X}}_{t-1}^j$. More generally, k-step-ahead forecasts are given by $\hat{\mathbf{X}}_{t+k|t}^j \equiv E_t\left[\mathbf{X}_{t+k} | \mathcal{I}_t^j\right] = \mathbf{A}^k\hat{\mathbf{X}}_t^j$.

Optimal actions are given by $\mathbf{a}_t^j = \frac{1}{2}\mathbf{B}_{aa}^{-1}\mathbf{B}_{xa}\hat{\mathbf{X}}_t^j$. The optimal signal coefficient and covariance matrix choices depend on the eigendecomposition of the loss matrix

$$\boldsymbol{\Omega} \equiv \frac{1}{4}\mathbf{B}_{xa}\mathbf{B}_{aa}^{-1}\mathbf{B}_{xa}^\top, \quad \boldsymbol{\Sigma}_{1|0}^{1/2}\boldsymbol{\Omega}\boldsymbol{\Sigma}_{1|0}^{1/2} = \mathbf{U}\boldsymbol{\Lambda}\mathbf{U}^\top. \tag{21}$$

Let $\boldsymbol{\Lambda}_1$ be the eigenvalues satisfying $\Lambda_i > \frac{1}{2}\mu$, and $\mathbf{U}_1$ the associated eigenvectors. One choice of optimal $\boldsymbol{\Sigma}_\eta$ is a diagonal matrix with elements given by $\sigma_{\eta,i}^2 = \left(2\Lambda_i/\mu - 1\right)^{-1}$. The corresponding signal coefficient matrix is then given by $\mathbf{H} = \mathbf{U}_1^\top\boldsymbol{\Sigma}_{1|0}^{-1/2}$.

All proofs are in Appendix A. The proof builds heavily on existing results in the rational inattention literature. Because the inattentive agents in our model have no idiosyncratic state variables and are myopic, the inattentive problem is very similar to a repeated static problem as in Kőszegi and Matějka (2020) or the dynamic generalization as in Miao et al. (2022). The difficulty of our setting is that the preferences and dynamics of our model contain both forward- and backward-looking variables (e.g., inflation and output are nonpredetermined, while the aggregate discount and wage cost-push factors are predetermined). However, once we have correctly specified the state space of the problem, Proposition 1 follows naturally.

The intuition behind the structure of how inattentive agents obtain information is the usual "water-filling" approach. Obtaining information is costly, but doing so helps agents make better economic choices. Instead of obtaining independent signals about each fundamental, inattentive consumers economize on information costs and reduce the dimensionality of the problem by learning about combinations of fundamentals in the manner most useful for taking optimal actions. The logic of the "water-filling" solution to the information problem implies that the factor structure of posterior beliefs may be lower than that of the data-generating process. An immediate corollary is that this will always hold for the $\mathcal{H}$ households in our model.

Corollary 1.1 (Hand-to-Mouth Optimal Signal)**.** *The loss matrix* $\mathbf{\Omega}$ *from* (21) *of a hand-to-mouth household* j *described in* (6) *has one non-zero eigenvalue* Λ_1*. If* $\Lambda_1 > \frac{1}{2}\mu$*, then the optimal signal can be written* $s_t^j = n_t^{\mathcal{H},*} + \eta_t^j$*, where the variance of the signal noise is* $\sigma_\eta^2 = (2\Lambda_1/\mu - 1)^{-1}$*. The prior and posterior mean jointly evolve according to*

$$\hat{n}_t^{\mathcal{H},j} = K(n_t^{\mathcal{H},*} + \eta_t^j) + (1-K)\tilde{n}_t^{\mathcal{H},*,j}, \quad K \equiv \frac{1}{1+\sigma_\eta^2}. \tag{22}$$

If instead $\Lambda_1 < \frac{1}{2}\mu$*, the agent receives no information and* $\hat{n}_t^{\mathcal{H},j} = \tilde{n}_t^{\mathcal{H},*,j} = 0$*.*

Recall that $\mathcal{H}$ households only make one active decision: how much labor to supply. Thus, when deciding to collect more information, it will always be optimal to learn more precisely about what this optimal choice is. Any other information that does not assist in this decision is therefore extraneous and (due to the cost of acquiring additional information) will be ignored in equilibrium. From Proposition 1, the optimal signal weights on the unobserved state will be (proportional to) the eigenvector of $\mathbf{\Omega}$ associated with the only non-zero eigenvalue.[13]

The assumption that $\mathcal{H}$ households are myopic ($\beta^j = 0$) is important for Corollary 1.1. This may seem surprising: under full information, optimal future actions $n_{t+k}^{\mathcal{H},*}$ are independent of previous decisions taken by the household. However, information is carried into the future and may be useful not only for the optimal action today, but also for future actions. When the dynamics of the optimal action are sufficiently rich, non-myopic agents ($\beta^j > 0$) will take these dynamic considerations into account (see Maćkowiak et al. 2018). We maintain the assumption of myopic hand-to-mouth agents not only for tractability, but also because this is an empirically relevant assumption for traditional "Keynesian" hand-to-mouth agents (see Aguiar et al. 2024).

[13] Appendices F.1 and F.3 derive the optimal signal structure for inattentive capitalist households and firms, respectively. Like hand-to-mouth consumers, we show that firms will also choose a signal with at most one dimension. For capitalists, the dimensionality of the optimal signal depends on the dynamics of optimal saving.

In order to map beliefs in our model to the empirical results, we formally represent "surveys" as functions of the variation in posterior beliefs. Denote the long-run covariance of the data-generating process and posterior beliefs regarding $\mathbf{X}_t$ as $\mathbf{\Sigma}_X \equiv \mathbb{V}ar\left[\mathbf{X}_t\right]$ and $\mathbf{\Sigma}_{\hat{X}} \equiv \mathbb{V}ar\left[\hat{\mathbf{X}}_t^j\right]$, respectively. Similarly, define the conditional covariances as $\check{\mathbf{\Sigma}}_X \equiv \mathbb{V}ar\left[\mathbf{X}_t \middle| \mathbf{X}_{t-1}\right]$ and $\check{\mathbf{\Sigma}}_{\hat{X}} \equiv \mathbb{V}ar\left[\hat{\mathbf{X}}_t^j \middle| \mathbf{X}_{t-1}, \hat{\mathbf{X}}_{t-1}^j\right]$. The long-run and conditional covariances of jump variables $\mathbf{y}_t$ are defined analogously, denoted by $\mathbf{\Sigma}_y$ and $\check{\mathbf{\Sigma}}_y$. In all cases, these covariances are computed with respect to the physical dynamics (17) and (20). Given the timing assumption of information collection, we interpret $\hat{\mathbf{X}}_t^j$ as the forecast of household j (though using the results from Proposition 1, we can extend these results to k-step-ahead forecasts $\hat{\mathbf{X}}_{t+k|t}^j$).

It is immediately clear that when faced with information-processing frictions, the distribution of survey-based beliefs will not be equivalent to the physical distribution from the data-generating process. More surprisingly, these differences can persist for even arbitrarily small information costs, as we show in the next Proposition.

Proposition 2 (Survey Belief Distribution, General Dynamics)**.** *Whenever information costs $\mu > 0$, long-run covariances of posterior beliefs differ from the data-generating process: $\mathbf{\Sigma}_{\hat{X}} \neq \mathbf{\Sigma}_X$ and $\mathbf{\Sigma}_y \neq \mathbf{\Sigma}_{\hat{y}}$. Moreover, if $\mathbf{\Omega}$ is not full rank, these distributions differ even in the limit as information costs disappear: $\lim_{\mu\to 0} \mathbf{\Sigma}_{\hat{X}} \neq \mathbf{\Sigma}_X$ and $\lim_{\mu\to 0} \mathbf{\Sigma}_{\hat{y}} \neq \mathbf{\Sigma}_y$. For any $\mu > 0$, the rank of posterior belief conditional covariances $\operatorname{rank} \check{\mathbf{\Sigma}}_{\hat{X}}, \operatorname{rank} \check{\mathbf{\Sigma}}_{\hat{y}}$ are bounded above by $\operatorname{rank} \mathbf{\Omega}$.*

Our results thus far are consistent with our empirical findings: household beliefs are well-described by a single factor, and the covariance of survey-based beliefs regarding aggregate variables will generally differ from that of the underlying data. However, the conditions under which the correlation of output and inflation in the data and in surveys have different signs will depend on the specifics of the model. Nevertheless, the following Corollary derives two general results in the case when signals are one-dimensional and the dynamics of the model are iid.

Corollary 2.1 (Survey Belief Distribution, Simplified Dynamics)**.** *Suppose that the dynamics matrix $\mathbf{A}_x = \mathbf{0}$ and the loss matrix $\mathbf{\Omega}$ has only one eigenvalue satisfying $\Lambda_1 > \frac{1}{2}\mu$, with associated eigenvector $\mathbf{u}_1$ and signal coefficient vector $\mathbf{h} = \mathbf{u}_1^\top \mathbf{\Sigma}_{1|0}^{-1/2}$.*

(i) If $\mathbf{h} \propto \mathbf{e}_k^\top$ (the k-dimension standard basis vector) so that $\mathbf{h}\mathbf{X}_t \propto x_{t,k}$, then for any two jump variables $y_{1,t}, y_{2,t} \in \mathbf{y}_t$, $\operatorname{sign} \mathbb{C}ov\left(\hat{y}_{t,1}^j, \hat{y}_{t,2}^j\right) = \operatorname{sign} \frac{\partial y_{t,1}}{\partial x_{t,k}} \cdot \frac{\partial y_{t,2}}{\partial x_{t,k}}$.

(ii) If $\mathbf{h}\mathbf{X}_t \propto y_{t,1}$ *for some jump variable* $y_{t,1} \in \mathbf{y}_t$*, then for any other jump variable* $y_{t,2} \in \mathbf{y}_t$*,* $\operatorname{sign} \mathbb{C}ov\left(\hat{y}^j_{t,1}, \hat{y}^j_{t,2}\right) = \operatorname{sign} \mathbb{C}ov\left(y_{t,1}, y_{t,2}\right)$*.*

The iid assumption in Corollary 2.1 simplifies the proof, but the intuition behind these results holds under more complicated dynamics (and also extends to k-step-ahead forecasts $\hat{\mathbf{X}}^j_{t+k|t}$). Result (i) says that if information-constrained agents learn only about one single state variable $x_{t,k}$, then the covariance between any jump variables in survey beliefs will have the same sign as the conditional response of these variables to $x_{t,k}$. Result (ii) on the other hand says that if agents are effectively learning about only one single jump variable $y_{t,1}$, then the covariance between this and any other jump variables in survey beliefs will have the same sign as the (actual) unconditional covariance of these variables. Intuitively, in either case agents are only learning about one single aggregate variable, and so conclusions about any other aggregate variable can only be drawn based on how variables endogenously covary within the model. In (i), this implies that beliefs about other aggregate variables are based on the (actual) conditional response to $x_{t,k}$. In (ii), this implies that beliefs about other variables are based on (actual) unconditional covariances.

We are now in a position to apply our results to the findings of Section 2. Propositions 1 and 2 show that dimension-reduction is a natural way for agents to economize on information costs, and so posterior beliefs will naturally feature a smaller factor structure than the data-generating process. Corollary 1.1 applies these findings to information-constrained agents in our model, who always reduce the dimensionality of the information problem to at most one dimension, consistent with a single "sentiment" factor. The conditions under which output and inflation beliefs negatively covary will depend on the specifics of the model.[14] Corollary 2.1 shows that even when the unconditional covariance between output and inflation in the data-generating process is positive, (i) gives us possible conditions under which surveys will show negative correlation of output and inflation beliefs. In particular, when inattentive agents find it optimal to pay attention to shocks that cause inflation and output to negatively covary, survey beliefs will feature this same negative covariance. On the other hand, (ii) shows that if agents find it optimal to effectively pay attention only to output (or inflation), then the covariance of output and inflation beliefs will necessarily match the data-generating process.

State Space Representation: Before we can determine the equilibrium dynamics

[14] Since we do not explicitly model unemployment, we proxy these beliefs as inversely related to beliefs about output (as output moves one-for-one with aggregate labor supply in the model).

of our model, note that in solving the information problem, we implicitly assumed the model can be represented by a (finite) set of state variables. This assumption is not innocuous, even in our simple case with hand-to-mouth agents solving (6). To see why, define the average of $\mathcal{H}$ households' prior beliefs of optimal labor supply by

$$m_t \equiv \frac{1}{\lambda}\int_0^{\lambda} \tilde{n}_t^{\mathcal{H},*,j}\,\mathrm{d}j\,. \tag{23}$$

Corollary 1.1 implies aggregate $\mathcal{H}$ labor supply is $n_t^{\mathcal{H}} = \frac{K}{\varsigma+\varphi}(\chi_n w_t - \gamma_t) + (1-K)m_t$. But then from (13), in equilibrium the real wage is a function of the average labor choice $n_t^{\mathcal{H}}$ and thus implicitly depends on average priors m_t. Hence, average priors are an endogenous state variable, and so in general the optimal signal will place non-zero weight on m_t. $\mathcal{H}$ households form prior and posterior beliefs $\tilde{m}_t^j, \hat{m}_t^j$ that will implicitly affect their labor supply decision $n_t^{\mathcal{H},j}$; in turn, average priors about these objects are themselves state variables, and so on. Even in our simple case of myopic hand-to-mouth agents, information frictions lead to an "infinite regress" problem.[15] However, our goal is to develop a tractable model, and fortunately there are special cases allowing us to sidestep this issue. Section 4 simplifies to the case of iid shocks. Section 5 allows for more complicated dynamics under certain parametric restrictions.

4 Analytical Results

In this section, we focus on the case of iid shocks. When the exogenous structural factors are iid, the Kalman filtering problem of inattentive consumers is simple, as priors are always at steady state values. We therefore avoid the dynamic complexity of the evolution of aggregate prior beliefs and are able to derive clear analytical results.

With iid dynamics ($\rho_v = \rho_\gamma = 0$), the state space is simply given by $\mathbf{X}_t \equiv \begin{bmatrix} v_t & \gamma_t \end{bmatrix}^\top$, and Proposition 1 implies that $\mathcal{H}$ household prior beliefs will always equal steady state values. Then Corollary 1.1 implies that the average labor supply decision of $\mathcal{H}$ households is simply $n_t^{\mathcal{H}} = Kn_t^{\mathcal{H},*}$. Combining this with equations (11) and (13), the equilibrium wage and $\mathcal{H}$ consumption are a function of wage cost-push shocks and output $w_t = \tilde{\omega}_\gamma \gamma_t + \tilde{\omega}_y y_t$, and $c_t^{\mathcal{H}} = \tilde{\zeta}_\gamma \gamma_t + \tilde{\zeta}_y y_t$, where the parameters $\tilde{\omega}_\gamma, \tilde{\omega}_y, \tilde{\zeta}_\gamma, \tilde{\zeta}_y$ are defined in equations (D9)-(D12).

[15] Dynamics follow a vector $AR(\infty)$ process, which can be approximated by an $ARMA(p,q)$ process (see e.g., Maćkowiak and Wiederholt 2015).

Finally, we assume that the central bank follows a simple Taylor rule $i_t = \phi_\pi \pi_t$, where i_t represents the deviations from the steady state interest rate $i^* = -\log\beta$, consistent with the zero inflation steady state. Then assuming ϕ_π is large enough, determinacy conditions are met; the assumption of white noise shocks implies that $\mathcal{K}$ expectations about future aggregate variables are always at steady state: $\mathbb{E}_t y_{t+1} = \mathbb{E}_t \pi_{t+1} = 0$. Equations (14) and (15) become

$$y_t = \frac{(1-\lambda)\varsigma^{-1}}{1-\lambda\tilde{\zeta}_y}(v_t - \phi_\pi \pi_t) + \frac{\lambda\tilde{\zeta}_\gamma}{1-\lambda\tilde{\zeta}_y}\gamma_t, , \quad \pi_t = \kappa_w \tilde{\omega}_\gamma \gamma_t + \kappa_w \tilde{\omega}_y y_t. \tag{24}$$

Inverting this system characterizes the equilibrium response of output and inflation to discount factor and wage cost-push shocks:

$$y_t = C_{y,v} v_t + C_{y,\gamma}\gamma_t, \quad \pi_t = C_{\pi,v} v_t + C_{\pi,\gamma}\gamma_t, \tag{25}$$

where the expressions for the coefficients are given by equations (D5)-(D8).

4.1 Beliefs

The following Proposition shows the conditions under which posterior beliefs feature negative correlation between output and inflation, while (unconditional) correlations are positive. We show that beliefs depend crucially on $\chi_n = 1 - \varsigma\left(1 - \tau^D/\lambda\right)$, which governs how the optimal labor supply decision of $\mathcal{H}$ households varies as a function of the real wage (11). Note that from Proposition 1, with iid shocks the k-step-ahead forecasts of inattentive agents will always return to steady state. However, recall in the model that $\hat{y}_t^j$ and $\hat{\pi}_t^j$ are the beginning-of-period forecasts of household j.

Proposition 3 (Hand-to-Mouth Posterior Beliefs)**.** *The unconditional correlation of output and inflation is positive iff*

$$C_{y,v} C_{\pi,v}\sigma_v^2 + C_{y,\gamma} C_{\pi,\gamma}\sigma_\gamma^2 > 0. \tag{26}$$

When $\chi_n \neq 0$, posterior beliefs of output and inflation are negatively correlated iff

$$\left(C_{y,v}\sigma_v^2 + \Xi C_{y,\gamma}\sigma_\gamma^2\right) \cdot \left(C_{\pi,v}\sigma_v^2 + \Xi C_{\pi,\gamma}\sigma_\gamma^2\right) < 0, \tag{27}$$

where $\Xi \equiv \frac{\chi_n(\tilde{\omega}_y C_{y,\gamma} + \tilde{\omega}_\gamma) - 1}{\chi_n \tilde{\omega}_y C_{y,v}}$. If $\chi_n = 0$, then (27) is equivalent to $C_{y,\gamma} C_{\pi,\gamma} < 0$.

The general conditions under which equations (26) and (27) hold are a function of the parameterization of the model, which are somewhat complicated. However, the following assumptions will help us derive more intuitive results.

Assumption 1. *Parameters are such that* $C_{y,v} > 0, C_{\pi,v} > 0, C_{y,\gamma} < 0, C_{\pi,\gamma} > 0$.

Assumption 1 implies that discount factor shocks v_t and wage cost-push shocks γ_t act like standard "aggregate demand" and "aggregate supply" shocks. This holds in the RANK version of the model, so for small enough λ will always be satisfied. However, this may fail if the feedback from the wage cost-push shock into aggregate output from the hand-to-mouth agents in (24) is large enough so that $C_{y,\gamma} > 0$.

The next corollary delivers two simple parameterizations which help deliver intuition regarding necessary and sufficient conditions for (27) to hold.

Corollary 3.1 (Hand-to-Mouth Posterior Beliefs)**.** *If Assumption 1 holds:*

(i) If $\chi_n = 0$*, then* (27) *is satisfied* $\forall \sigma_\gamma > 0$.

(ii) If $\chi_n \neq 0$*, then* $\exists\ \overline{\sigma_\gamma}$ *such that* $\sigma_\gamma < \overline{\sigma_\gamma}$ *implies that* (27) *does not hold.*

To understand case (i), note that whenever $\chi_n \approx 0$, fluctuations in the real wage have very small effects on the optimal labor decision. The natural benchmark case of log utility and no transfers satisfies this condition: the optimal labor choice is independent of the real wage due to offsetting income and substitution effects. More generally, $\chi_n \approx 0$ with $\varsigma \neq 1$ implies non-zero transfers that hedge $\mathcal{H}$ households from demand-driven movements in the real wage. Since firm profits are inversely related to labor costs (wages), a decline in labor income is offset by increased transfers. Case (i) thus implies that the optimal signal loads entirely on the aggregate wage cost-push shock γ_t. Because this signal contains no other information about realizations of other aggregate variables, posterior beliefs about all other outcomes are derived from the (conditional) response of the model to these shocks, so household posterior beliefs will always feature a negative correlation between output and inflation. For small enough values of cost-push shock volatility σ_γ^2, equation (26) will be satisfied, and actual inflation and output feature an unconditional positive correlation.

In case (ii), if the volatility of supply shocks is very small, then it is not optimal to dedicate much attention to these shocks. Instead (so long as $\chi_n \neq 0$), the optimal signal will place weight on the real wage, which in equilibrium will be driven more by discount factor (demand) shocks. Thus, posterior beliefs regarding output and inflation will be driven by the conditional response of the model to these demand shocks, implying a positive correlation in beliefs (as well as the data-generating process).[16]

4.2 Aggregate Responses

Next, we study the equilibrium effects of aggregate shocks. We are particularly focused on how the dynamics of our model differ from standard New Keynesian models. The following Proposition shows how the dynamics of our model depend on the amount of hand-to-mouth households and the degree of information frictions.

Proposition 4 (Aggregate Dynamics)**.** *In the limit of no hand-to-mouth agents ($\lambda \to 0$) and no information costs ($K \to 1$):*

(i) First derivatives of conditional responses with respect to the fraction of hand-to-mouth agents (λ) are

$$\frac{\partial C_{y,v}}{\partial \lambda} \to \frac{\varphi(1-\chi_n)}{(\varsigma + (\varsigma+\varphi)\kappa_w\phi_\pi)^2}, \quad \frac{\partial C_{y,\gamma}}{\partial \lambda} \to \frac{\varsigma\varphi(1-\chi_n)}{(\varsigma+\varphi)(\varsigma + (\varsigma+\varphi)\kappa_w\phi_\pi)^2},$$
$$\frac{\partial C_{\pi,v}}{\partial \lambda} \to \frac{(\varsigma+\varphi)\kappa_w\phi_\pi(1-\chi_n)}{(\varsigma + (\varsigma+\varphi)\kappa_w\phi_\pi)^2}, \quad \frac{\partial C_{\pi,\gamma}}{\partial \lambda} \to \frac{\varsigma\kappa_w\phi_\pi(1-\chi_n)}{(\varsigma + (\varsigma+\varphi)\kappa_w\phi_\pi)^2}.$$

(ii) Second derivatives of conditional responses with respect to the fraction of hand-to-mouth agents (λ) and information costs ($-K$) are

$$-\frac{\partial^2 C_{y,v}}{\partial\lambda\partial K} \to \frac{-\chi_n}{\varsigma + (\varsigma+\varphi)\kappa_w\phi_\pi}, \quad -\frac{\partial^2 C_{y,\gamma}}{\partial\lambda\partial K} \to \frac{\varsigma(1-\chi_n) + (\varsigma+\varphi)\kappa_w\phi_\pi}{(\varsigma+\varphi)(\varsigma + (\varsigma+\varphi)\kappa_w\phi_\pi)},$$
$$-\frac{\partial^2 C_{\pi,v}}{\partial\lambda\partial K} \to 0, \quad -\frac{\partial^2 C_{\pi,\gamma}}{\partial\lambda\partial K} \to 0.$$

In Proposition 4 we focus on the behavior of the model near a neighborhood of the full-information RANK benchmark. When $\lambda = 0$, Assumption 1 holds and the model behaves as expected: v_t and γ_t act as typical aggregate demand and supply shocks (where increases in either factor raise inflation; increases in v_t raise output, while increases in γ_t

[16] Proposition 6 in Appendix E derives similar conditions if $\mathcal{H}$ households actively choose consumption (rather than labor supply). Appendices F.2 and F.4 derive expressions for the correlation structure of output and inflation beliefs of inattentive capitalists and firms (respectively). We derive sufficient conditions under which belief correlations are negative, while the actual correlation between inflation and output is positive. Analogous to Corollary 3.1, we find a wide array of parameter restrictions under which firm beliefs will be negatively correlated $\forall\sigma_\gamma > 0$. For inattentive capitalists, we also derive sufficient conditions, but unlike Corollary 3.1, these conditions are not satisfied $\forall\sigma_\gamma > 0$.

lower output). Result (i) shows that the existence of hand-to-mouth households affects how output responds to shocks. Whenever $\chi_n \leq 1$, hand-to-mouth agents *amplify* the output reaction to demand shocks, but *mitigate* the output reaction to supply shocks (and vice versa if $\chi_n \geq 1$).

The amplification of aggregate demand shocks is because the optimal consumption response of $\mathcal{H}$ households moves more than one-for-one with aggregate output whenever $\chi_n \leq 1$. The intuition is the same as Bilbiie (2020). The condition $\chi_n \leq 1$ is equivalent to the condition $\chi_c \geq 1$; this implies that all else equal, when aggregate income increases, $\mathcal{H}$ household consumption increases by more than $\mathcal{K}$ consumption, and $\mathcal{H}$ labor supply increases by less than $\mathcal{K}$ labor supply (or decreases by more if $\chi_n < 0$).

On the other hand, the same condition $\chi_n \leq 1$ implies supply shocks are mitigated. The reason is the following: a wage cost-push shock means that marginal costs for firms increases and therefore desired production falls. However, sticky prices imply that output falls by less than it otherwise would. Therefore, aggregate income is higher than it would be otherwise, and so for the same reason as discussed previously, all else equal, the $\mathcal{H}$ household consumption falls by less than the $\mathcal{K}$ households'. Then the same income amplification channel in this context implies that in equilibrium output falls by less than the RANK benchmark.

The effects on inflation follow from the usual New Keynesian Phillips curve logic: inflation increases in response to higher marginal costs, which are a function of aggregate output. Inflation reactions to demand shocks are amplified if and only if the response of output is amplified. For wage cost-push shocks, the direct effect is to raise marginal costs, but this is dampened by the equilibrium decline in output. Thus, when the cost-push effects on output are mitigated, the equilibrium response of inflation is amplified.

The results above are when $\mathcal{H}$ households make optimal full-information choices. Result (ii) shows how the introduction of information costs changes the degree of amplification and mitigation discussed in (i).[17] We can think of the introduction of information costs as causing the $\mathcal{H}$ households to make mistakes when choosing labor supply. Note that the sign of $-\frac{\partial^2 C_{y,v}}{\partial \lambda \partial K}$ is determined by the sign of χ_n, not $1 - \chi_n$. Suppose $\chi_n < 0$. Then this result says that information costs lead to *additional amplification* of the output response to demand shocks. This may be surprising: typically, rational inattention

[17] Note that $K = 1$ is equivalent to no costs of information ($\mu = 0$). The derivatives are evaluated with respect to $-K$, and so should be interpreted as the effect of increasing information costs. As shown in Section 3.1, in the case where agents receive a one-dimensional signal, the choice of Kalman gain K and the signal-to-noise ratio σ_η are inversely related, and both are monotonic functions of μ.

models are characterized by *underreaction.* The intuition for this result is as follows. In the FIRE-RANK limit, an increase in output increases the real wage. When $\chi_n < 0$, $\mathcal{H}$ households find it optimal to increase consumption but reduce labor when the real wage increases. Information frictions lead to an underreaction of $\mathcal{H}$ labor supply to changes in the real wage. Because the $\mathcal{H}$ household labor supply mistake is supplying too much labor, $\mathcal{H}$ consumption overreacts. The result follows from the amplification of demand shocks (since $\chi_n < 1$).

If $0 \leq \chi_n \leq 1$, then $\mathcal{H}$ households increase labor supply, but by less than under full information. Hence, $\mathcal{H}$ consumption also underreacts. Thus, while TANK implies amplification, information costs weaken the amplification channel. Finally, if $\chi_n \geq 1$, we get the same underreaction of both $\mathcal{H}$ consumption and labor supply. However, in this case TANK implies mitigation of the output reaction to demand shocks; thus, increasing information costs implies further mitigation.

Additionally, regardless of χ_n, for large enough ϕ_π we have that $-\frac{\partial^2 C_{y,\gamma}}{\partial\lambda\partial K} > 0$. The reason is that when ϕ_π is large enough, near the RANK limit the equilibrium optimal labor choice of $\mathcal{H}$ households is decreasing in γ_t (regardless of χ_n; even if $\chi_n \gg 0$, for large enough values of ϕ_π the equilibrium increase in wages will be small enough to imply a decline in optimal $\mathcal{H}$ labor choice). Under these conditions, an increase in information costs implies that actual $\mathcal{H}$ labor decisions underreact, that is, decline by less than the full-information benchmark. Thus, increasingly costly information implies more mitigation (if $\frac{\partial C_{y,\gamma}}{\partial\lambda} > 0$) or less amplification (if $\frac{\partial C_{y,\gamma}}{\partial\lambda} < 0$) of supply shocks relative to the full-information TANK model.

This result is reversed if ϕ_π is relatively small (and χ_n is large enough), so that the equilibrium hand-to-mouth response to a labor disutility shock is to *increase* labor supply. This will only occur if $\chi_n \gg 1$, which is possible only if transfers $\tau^D/\lambda > 1$.

Finally, we see that increasing information costs have no further effects on the transmission of shocks to inflation. This follows from two assumptions in the model. First, firm production is linear in labor (constant returns to scale); and second, the central bank only reacts to inflation when setting the policy rate. Intuitively, information costs cause the $\mathcal{H}$ households to make mistakes when choosing how much labor to supply; from the production function of firms, these labor supply mistakes are transmitted one-to-one (per unit of labor) to output. But this additional production is simply consumed by the $\mathcal{H}$ households, and thus in equilibrium does not lead to any changes in the pricing behavior of firms. The ensuing change in aggregate output does not affect the policy rate, and therefore does not change $\mathcal{K}$ household decisions.

Expectation Manipulation Policies: We utilize our model to explore the aggregate implications of policies that manipulate inflation expectations. Usually, such policies are considered in situations where a policymaker wishes to boost output today by raising inflation expectations (Coibion et al. 2020a). In models featuring FIRE, the only way in which a policymaker can manipulate expectations is by credibly committing to future policy actions. Without such future policy commitments, FIRE beliefs will be pinned down by the underlying dynamics of the model.

However, the existence of agents in our model with non-FIRE expectations potentially opens the door to other policies aimed at manipulating inflation expectations. We consider a policymaker who is able to manipulate the inflation expectations $E_t^j \pi_t$ of inattentive agents. We abstract from how the policymaker can manipulate the beliefs of the $\mathcal{H}$ households without taking any concrete policy actions. Instead, we assume such a policy is feasible, and use our model to study the aggregate consequences.

Formally, assume that the policymaker manipulates the average level of signals received by $\mathcal{H}$ households. The signal received by household j is now

$$s_t^j = n_t^{\mathcal{H},*} + \alpha z_t + \eta_t^j, \tag{28}$$

where z_t is common across all households $j \in [0, \lambda]$.[18] Choose $\alpha = \pm 1$ so that an increase in z_t is associated with an increase in inflation expectations: $\frac{\partial E_t^j \pi_t}{\partial z_t} > 0$. Will such a policy of manipulating inflation expectations lead to an increase in output? It turns out that the conditions under which this policy will fail are closely tied to the conditions that lead to negatively correlated inflation and output beliefs, as shown in the following Proposition.

Proposition 5 (Expectation Manipulation)**.** *Suppose $\mathcal{H}$ households receive the signal (28). Then $\frac{\partial y_t}{\partial z_t} > 0$ iff $C_{\pi,v}\sigma_v^2 + \Xi C_{\pi,\gamma}\sigma_\gamma^2 > 0$. If Assumption 1 holds and $\chi_n = 0$, then this condition is never satisfied.*

Proposition 5 provides a strong note of caution to policymakers: under "usual" parameter restrictions where inflation and output posterior beliefs are negatively correlated, the expectation manipulation policy will fail to boost output. This provides a

[18] Clearly a rationally inattentive agent would always choose a signal structure that puts zero weight on z_t whenever there is the possibility that $z_t \neq 0$. One way to generate this signal structure is to assume z_t has zero variance, so inattentive agents would be indifferent to placing weight on z_t. In this interpretation, the policy should be thought of as a "one-off" (zero-probability) manipulation of inflation expectations.

theoretical justification for the concerns raised in Bachmann et al. (2015). Intuitively, the policy increases the inflation expectations by signaling to $\mathcal{H}$ households that a wage cost-push shock is likely. This causes $\mathcal{H}$ households to reduce labor supply and consumption. The firms and $\mathcal{K}$ household optimality conditions are unchanged (and firms face constant returns to scale), so this reduction in consumption translates into a one-to-one reduction in aggregate output.

5 Dynamic Model

Relaxing the assumption of iid shocks, we study the model with more complicated dynamics when $\rho_v \neq 0, \rho_\gamma \neq 0$. Aggregate $\mathcal{H}$ labor supply is given by $n_t^{\mathcal{H}} = K n_t^{\mathcal{H},*} + (1-K)m_t$, where m_t are average priors of $\mathcal{H}$ households regarding the optimal labor decision (given by (23)). As discussed in Section 3.1, despite the simple AR(1) process for exogenous shocks, the dynamics of average priors m_t will in general be intractable. Fortunately, under the parametric assumption that $\chi_n = 0$, average priors evolve according to

$$m_t = \rho_\gamma (1-K) m_{t-1} - \rho_\gamma K \frac{1}{\varsigma + \varphi} \gamma_{t-1}. \tag{29}$$

The reason is that whenever $\chi_n = 0$, the optimal labor decision under full information is simply $n_t^{\mathcal{H},*} = -\frac{1}{\varsigma+\varphi}\gamma_t$. Thus, the Kalman updating process simply tracks an exogenous variable with known dynamics. The "infinite regress" problem only shows up if the optimal signal must track endogenous variables (such as the wage), which in equilibrium depend on the choices of other information-constrained agents.

Recall from (11) that $\chi_n = 0 \iff \varsigma^{-1} = 1 - \tau^D/\lambda$. While not without loss of generality, it nests the natural benchmark of log utility and no transfers. Thus, the gains in terms of tractability do not require unreasonable parametric assumptions.

Under the assumptions of AR(1) shocks and $\chi_n = 0$, we therefore have that $\mathbb{E}_t \Delta v_{t+1} = (\rho_v - 1)v_t$, $\mathbb{E}_t \Delta \gamma_{t+1} = (\rho_\gamma - 1)\gamma_t$, and $\mathbb{E}_t \Delta m_{t+1} = (\rho_\gamma(1-K) - 1)m_t - \frac{\rho_\gamma K}{\varsigma+\varphi}\gamma_t$. Then the dynamics of output and inflation are functions of v_t, γ_t and m_t:

$$\begin{aligned}\left(1-\lambda\tilde{\zeta}_y\right)\mathbb{E}_t\Delta y_{t+1} &= (1-\lambda)\varsigma^{-1}\left(i_t-\mathbb{E}_t\pi_{t+1}-v_t\right)\\ &\quad+\lambda\left(\tilde{\zeta}_\gamma(\rho_\gamma-1)-\zeta_n\rho_\gamma\frac{K}{\varsigma+\varphi}\right)\gamma_t+\lambda\zeta_n(\rho_\gamma(1-K)-1)m_t, \end{aligned}\tag{30}$$

$$\pi_t=\kappa_w\left[\tilde{\omega}_\gamma\gamma_t+\tilde{\omega}_y y_t+\omega_n m_t\right]+\beta\mathbb{E}_t\pi_{t+1}, \tag{31}$$

$$i_t=\phi_\pi\pi_t+\phi_y y_t. \tag{32}$$

Equations (30) and (31) are somewhat complicated functions of the underlying parameters. However, the qualitative differences from the usual RANK model are apparent. First, the reaction of output to interest rate changes (and discount factor shocks) is not pinned down only by $\mathcal{K}$ household preferences (and similarly for inflation reactions to output and cost-push shocks). Second, output also reacts directly to wage cost-push shocks. Third, both output and inflation depend on the sluggish belief updating of information-constrained households.

5.1 Calibration

We choose the natural baseline of log utility ($\varsigma=1$) and no transfers ($\tau^D/\lambda=0$), which is consistent with $\chi_n=0$. The discount factor is set to $\beta=0.9975$, consistent with an annualized long-run interest rate of approximately 4% (quarterly frequency). We choose standard Taylor rule coefficients of $\phi_\pi=1.5$ and $\phi_y=0.1$. In our baseline, we set the fraction of hand-to-mouth households $\lambda=0.33$ (based on estimates in Kaplan et al. 2014 and Aguiar et al. 2024).[19] The remaining parameters are calibrated in order to match aggregate moments from U.S. data from 1978:Q1 to 2019:Q4.

We proxy y_t (output deviations from steady state) by the year-over-year growth rate in real GDP. For π_t (inflation deviations from steady state), we use the year-over-year growth rate of CPI. For w_t (wage deviations from steady state), we use the year-over-year growth rate in non-farm business sector unit labor costs. We choose unit labor costs because labor is the only productive input in our model, and aggregate cost-push shocks act through labor compensation. Data is from FRED (GDPC1, CPIAUCSL, ULCNFB) and detrended using the Hodrick-Prescott filter.

[19]While this is a natural calibration target, in the model λ simultaneously determines the fraction of information-constrained agents; based on our empirical survey results, this fraction may be larger. Appendix Figures G3-G4 explore our model using alternative choices of λ.

Finally, we utilize survey data as proxies for posterior beliefs of information-constrained agents. We continue to use the MSC because of the long sample period. However, most questions are qualitative and so are not well-suited to calibrating our quantitative model. Inflation expectations are one of the few exceptions recorded quantitatively, so we use this data to proxy for $\hat{\pi}_t^j$ (posterior beliefs of inflation deviations from steady state).

Table 2: Model Calibration

Parameter	Value	Description	Target
Panel A:			
β	0.9975	Discount Factor	Long-run rate
ς	1.0	CRRA	Log-utility, $\chi_n = 0$
$\frac{\tau^D}{\lambda}$	0.0	Transfers	Log-utility, $\chi_n = 0$
λ	0.33	Hand-to-Mouth	Fraction 1/3
ϕ_π	1.5	Taylor Rule	Inflation Coeff.
ϕ_y	0.1	Taylor Rule	Output Coeff.
Panel B:			
φ	0.5305	$\sigma(w_t)$	1.5682
κ_w	0.198	$\rho(y_t, \pi_t)$	0.0689
ρ_v	0.7131	$\rho(y_t, y_{t-1})$	0.8074
ρ_γ	0.8242	$\rho(\pi_t, \pi_{t-1})$	0.749
σ_v	0.7616	$\sigma(y_t)$	1.5757
σ_γ	1.7847	$\sigma(\pi_t)$	1.2007
K	0.149	$\rho\left(\hat{\pi}_t^j, \pi_t\right)$	0.3306

Notes: Panel A reports parameters set to standard values. Panel B reports our parameters which are calibrated to match empirical moments. For each parameter in Panel B, we include the moment which is most closely related; however, the calibration exercise jointly determines the parameter values.

Table 2 summarizes our calibration. We jointly calibrate the remaining model parameters by targeting second moments in the data. First, we target the volatility of y_t, π_t, and w_t, as well as the (quarterly) autocorrelation of y_t and π_t. These moments are informative about parameters in the model governing the volatility and persistence of shocks (σ_v, σ_γ, ρ_v, ρ_γ), as well as the inverse Frisch elasticity (φ). Additionally, we target the correlation of y_t and π_t (which is informative about the slope of the Phillips curve κ_w). We also target the correlation of $\hat{\pi}_t^j$ and π_t (which is informative about information frictions K).

Our parameter estimates are broadly in line with typical calibrations used in the New Keynesian literature. Our calibration implies that our supply factor shocks are more persistent than demand shocks, but that they are jointly consistent with a weak positive correlation of output and inflation over the sample. We find a somewhat large Frisch elasticity: our estimate $\varphi^{-1} > 1$. This is in line with the evidence from the "macro" literature of wage elasticities, but contrasts with "micro" estimates.

We estimate a large degree of information frictions due to the overall low degree of correlation between inflation beliefs across households and actual inflation. Although inflation expectations are well-suited for estimating information costs in the model, Appendix G re-estimates the model across a range of values $K \in (0, 1)$. Appendix Figure G1 shows that most of the parameters are relatively insensitive to the degree of information frictions. Appendix Figure G2 shows that beliefs regarding output and inflation remain negatively correlated even for very low information costs.

5.2 Dynamic Responses

Using the calibrated model, we explore the response to demand and supply shocks. We consider two initial conditions: starting from steady state, and an alternative where $\mathcal{H}$ household priors m_t are "low" (two standard deviations below steady state).

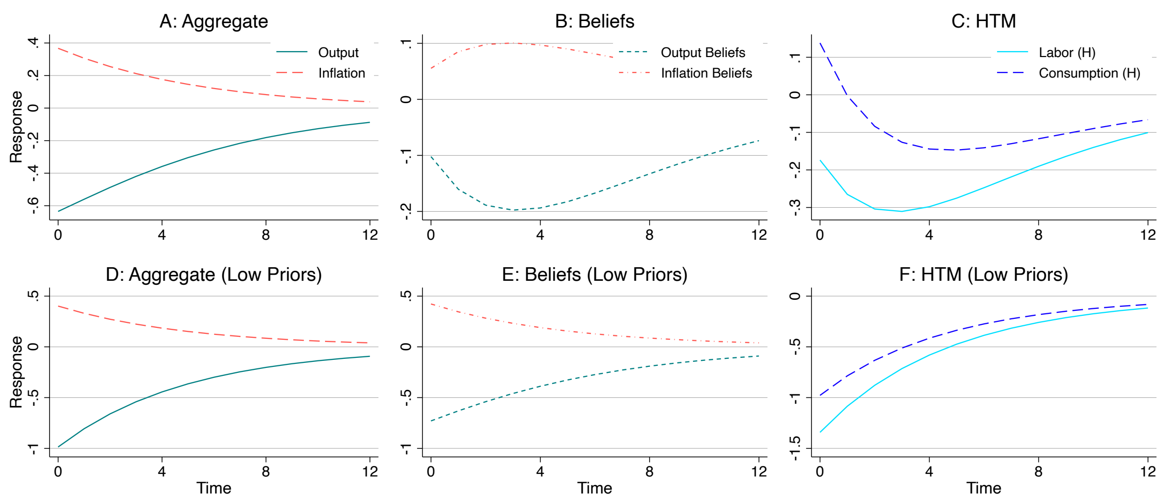

Figure 5: Response to Supply Shock

Notes: IRFs following an increase in the wage cost-push shock. The first column reports aggregate output and inflation; the second column reports average $\mathcal{H}$ beliefs; the third column reports average $\mathcal{H}$ labor and consumption. Each row corresponds to different initial conditions regarding $\mathcal{H}$ household priors (steady state or low, respectively).

Figure 5 reports model IRFs following a standard deviation shock to the supply factor innovation $\varepsilon_{t,\gamma}$. Each row corresponds to different initial conditions regarding $\mathcal{H}$ household priors (steady state or low, respectively). Focusing on the first row, Panel A reports the dynamics of output (solid line) and inflation (dashed line) following the shock. On impact, the supply factor shock leads to a fall in output and an increase in inflation. Inflation then falls towards steady state, while output increases back towards steady state as the shock dissipates.

Panel B reports how $\mathcal{H}$ household beliefs regarding output and inflation react to the shock.[20] As discussed above, $\mathcal{H}$ households learn about supply shocks, and thus the increase in γ_t leads $\mathcal{H}$ households to update their beliefs. Although quantitatively different from the realizations of output and inflation, output and inflation beliefs move in line with realizations. However, $\mathcal{H}$ household actions differ from the full-information benchmark. As shown in Panel C, household labor supply declines following the shock (as shown in the solid line), but it underreacts relative to a full-information baseline, which implies that $\mathcal{H}$ consumption actually increases (as shown in the dashed line). As additional information is collected in the next period, $\mathcal{H}$ labor supply on average declines even further (at which point $\mathcal{H}$ consumption also drops below steady state). The sluggish reaction to information leads to aggregate hump-shaped movements in $\mathcal{H}$ household actions.

Panels D, E, and F report the same responses when initial priors m_t are low. In this case, $\mathcal{H}$ households *ex ante* believe that the optimal labor supply decision is below steady state because the supply factor is high. Thus, $\mathcal{H}$ households on average already believe that the likelihood of being in a supply-driven recession is large. Thus, on impact the supply shock leads to a larger decline in output driven by the larger decline in $\mathcal{H}$ household labor supply. In this case, $\mathcal{H}$ household consumption is initially below steady state and decreases even further as more information is collected. All else equal, the larger fall in output puts downward pressure on the policy rate, and thus inflation rises by more than in the case where m_t is at steady state.

Figure 6 conducts the same set of experiments, but following a standard deviation shock to the demand factor innovation $\varepsilon_{t,v}$. As shown in Panel A, on impact the demand factor shock leads to a boost in output and an increase in inflation. Both output and inflation then monotonically decline towards steady state as the shock dissipates. Panel B reports how $\mathcal{H}$ household beliefs regarding output and inflation react to the shock. As discussed above, $\mathcal{H}$ household signals load entirely on supply shocks. Thus, following a demand shock when $\mathcal{H}$ household priors are at steady state, average beliefs do not react at all. This implies that $\mathcal{H}$ households on average do not adjust their labor supply (as shown in the solid line in Panel C). Due to the increase in wages following the demand-driven expansion, $\mathcal{H}$ household consumption on average therefore increases (as shown in

[20] We focus on posterior beliefs (beginning-of-period forecasts) for simplicity. The dynamics of one-year-ahead inflation and output forecasts (as well as state variables) are in Appendix Figures G5-G6.

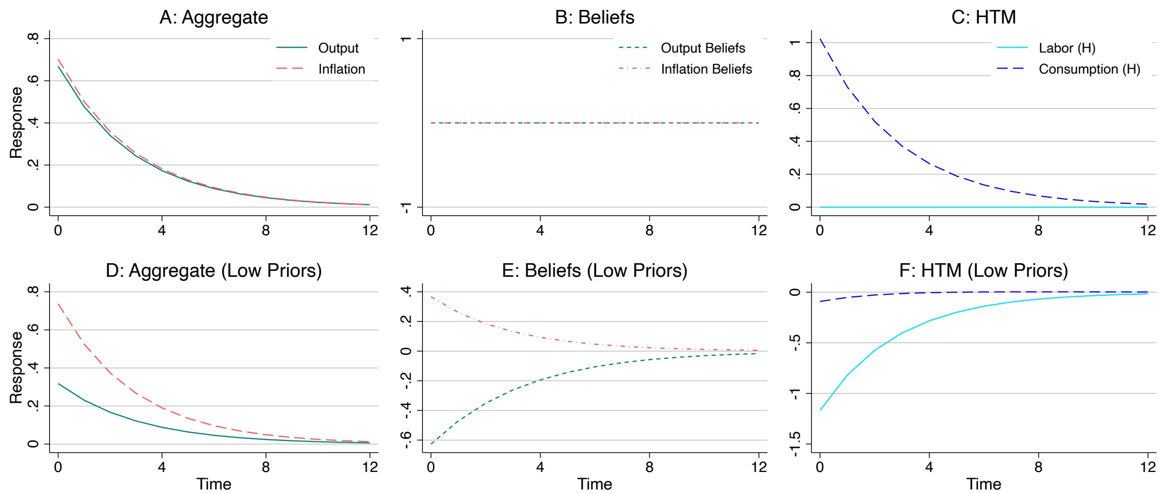

Figure 6: Response to Demand Shock

Notes: IRFs following an increase in the discount factor shock. The first column reports aggregate output and inflation; the second column reports average $\mathcal{H}$ beliefs; the third column reports average $\mathcal{H}$ labor and consumption. Each row corresponds to different initial conditions regarding $\mathcal{H}$ household priors (steady state or low, respectively).

the dashed line in Panel C).

Panels D, E, and F report the same responses when initial priors m_t are low. In this case, $\mathcal{H}$ households *ex ante* believe that the likelihood of entering a supply-driven recession is high and that the optimal labor supply decision is below steady state. $\mathcal{H}$ households therefore initially reflect this belief: inflation expectations are high and output beliefs are low. Because of this, $\mathcal{H}$ household labor supply is reduced relative to the previous case, and $\mathcal{H}$ consumption also declines. Thus, while the response to the demand shock is expansionary, the initial low $\mathcal{H}$ priors imply the expansion is smaller than otherwise. As time passes, while the $\mathcal{H}$ households do not learn about the level of aggregate demand, their signals are consistent with the supply factor being at steady state, and thus $\mathcal{H}$ households sluggishly update their beliefs towards steady state.

Expectation Manipulation Dynamics: Figure 7 repeats the expectation policy experiment where the central bank increases inflation expectations. $\mathcal{H}$ households conclude that inflation is high due to a supply-driven recession. Therefore, output beliefs fall and these households decrease their labor supply. This implies a nearly one-for-one reduction in consumption. Thus, aggregate output declines. Since aggregate output falls, a cut in the policy rate puts upward pressure on inflation. Inflation therefore rises on impact, before subsiding as beliefs return to steady state.

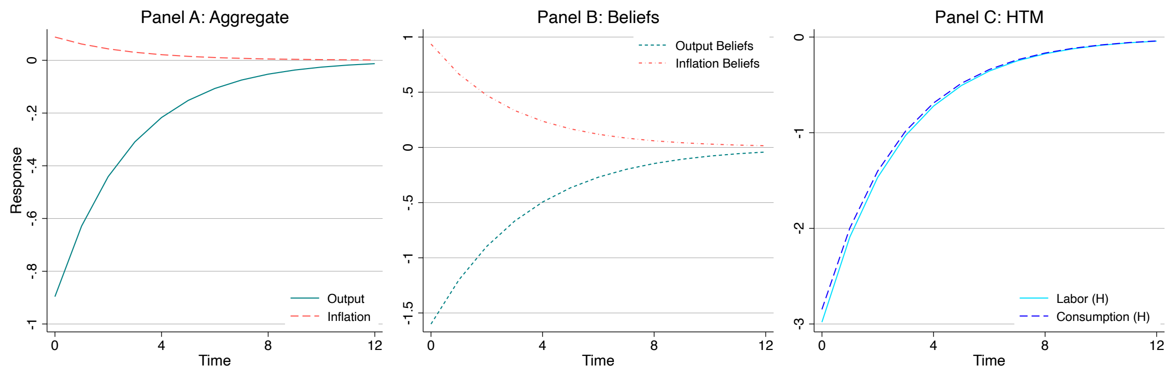

Figure 7: Response to Expectation Shock

Notes: IRFs following an expectation manipulation policy shock. Panel A reports aggregate output and inflation; Panel B reports average $\mathcal{H}$ beliefs; Panel C reports average $\mathcal{H}$ labor and consumption.

Note that the response of inflation is relatively small: output declines by 0.9% but inflation only increases by less than 0.1%. The decisions of $\mathcal{K}$ households (with FIRE beliefs) are only affected through changes in the policy rate; because these are small, changes in equilibrium wages are also small. Thus, the implied increase in consumption from $\mathcal{H}$ households is produced nearly one-for-one from the increase in $\mathcal{H}$ labor supply.[21]

6 Direct Tests of the Model Mechanisms

Our model rationalizes the puzzle that consumers tend to have "stagflationary" views (perceive inflation as countercyclical). We now go a step further and provide direct evidence in favor of our specific model mechanisms. We test three hypotheses: (1) less attentive consumers have stronger countercyclical perceptions of inflation; (2) consumers whose reasoning relies more heavily on supply-side factors have stronger countercyclical perceptions of inflation; and (3) consumer beliefs react more strongly to aggregate supply factors compared to aggregate demand factors. In Sections 6.1, 6.2, and 6.3, we discuss different ways of empirically testing each of these respective hypotheses. In all cases, we find strong evidence consistent with the channels of our model. Thus, we not only rationalize the puzzle of consumers' "stagflationary" views, but the data support the

[21] As discussed above, if firm production features decreasing returns to scale, inflation will react more strongly and the quantitative aggregate responses will differ. However, the qualitative reaction of output and $\mathcal{H}$ household decisions are similar. In particular, the central bank's policy of raising inflation expectations is counterproductive and results in a decline in aggregate output.

specific mechanisms of our model: consumers' countercyclical perception of inflation is *attention-driven* and reflects a *supply-side* view of the world.

6.1 Attention

We test our first hypothesis that less attentive consumers have stronger countercyclical perceptions of inflation by estimating interaction regressions of the form

$$\hat{\pi}_{i,t} = \sum_{j=1}^{J} \beta^j \, \hat{f}_{i,t} \times \mathbb{1}\{a_{i,t} = j\} + \gamma \mathbf{X}_{i,t} + \epsilon_{i,t}. \tag{33}$$

As in Section 2, we estimate the relationship between $\hat{f}_{i,t}$ (our baseline MCA factor) and different measures of inflation expectations $\hat{\pi}_{i,t}$ across consumers i and time t. But now the estimated coefficients β^j allow us to study how this transmission differs across various proxies for more or less attention $a_{i,t} = 1, \ldots, J$. In each regression, $\mathbf{X}_{i,t}$ includes time fixed effects and dummy variables for each attention measure $a_{i,t} = 1, \ldots, J$ directly.

We consider three different proxies for measuring a given respondent's degree of attention $a_{i,t} = 1, \ldots, J$ in a consumer survey. The first utilizes the panel aspect of consumer surveys. All else equal, we expect respondents to dedicate more thought to survey responses in follow-up interviews compared to the initial survey.[22]

Next, we examine the degree of rounding in consumers' numeric forecasts. The phenomenon that consumer survey responses tend to bunch at multiples of five or ten is well-known (Binder 2017). All else equal, we expect respondents who devote less attention or effort to their survey responses to be more likely to report rounded forecasts.

Finally, we exploit recent methodological changes in the Michigan Survey. In 2024, the MSC switched from phone-based to online interviews. During the months of April, May, and June 2024, the MSC simultaneously conducted phone-based on online interviews. All else equal, we expect consumers who respond online to dedicate less attention than those responding by phone.[23]

Figure 8 reports the interaction coefficients $\hat{\beta}^j$ across these different proxies using the MSC. Each panel uses different inflation expectations as the dependent variable in (33): Panel A uses 1-year inflation expectations; Panel B uses 5-year inflation expectations; Panels C and D use 1-year and 5-year gas price expectations, respectively. The

[22] For instance, Brave et al. (2024) show that longer tenure in SCE leads to smaller forecast errors.

[23] Hsu (2024) discusses the transition and notes the induced methodological effects.

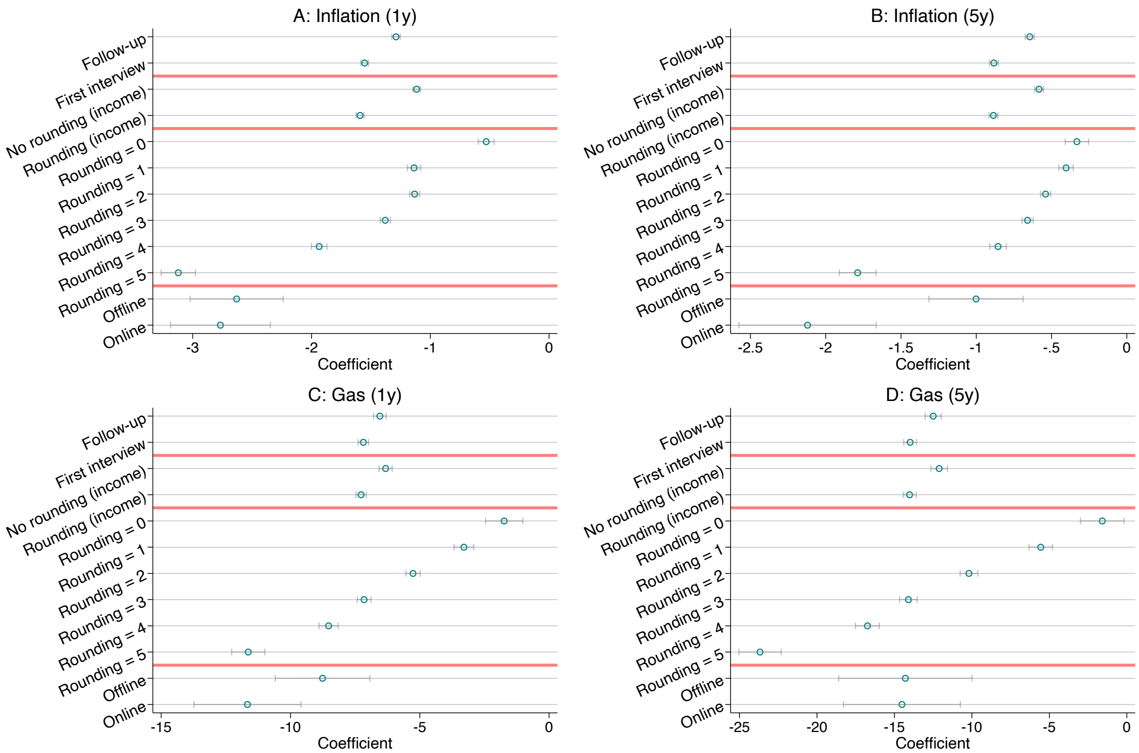

Figure 8: MSC Inflation Perceptions and Attention Proxies

Notes: estimates of (33) using proxies for attention. Scatter points represent estimated interaction coefficients corresponding to the attention proxy described on the y-axis. Solid red lines delineate different sets of regressions. Each panel corresponds to different choices of the dependent variable. Horizontal lines represent 95% confidence intervals.

solid red lines serve to distinguish between estimates of (33) using the different proxies for attention described above; the y-axis labels these different proxies. More negative estimates of $\hat{\beta}^j$ imply that consumers have more countercyclical perceptions of inflation.

The first set of coefficients (above the first red line) compares the attention proxy based on whether a respondent was contacted for a follow-up interview or an initial interview (recall that in the MSC, some respondents are contacted again six months after their initial interview for a follow-up). Across the four different inflation expectations measures, we see evidence in favor of our hypothesis: respondents in their initial interviews perceive inflation as more countercyclical compared to follow-ups. The magnitude is economically meaningful as well: a unit (one standard deviation) decrease in the estimated first component $\hat{f}_{i,t}$ is associated with an increase in 1-year inflation expectations of approximately 1.2 percentage points in follow-up interviews, but this pass-through is greater than 1.5 percentage points during initial interviews. We find similar results for longer-horizon expectations or gas price expectations (note that the relationship between the first component $\hat{f}_{i,t}$ and gas price expectations is much stronger than for general inflation expectations).

The next set of coefficients (between the first and second red lines) is based on our rounding proxy for attention. We first define the attention proxy based only on personal income forecasts; we set our attention dummy variable to one if the respondent's personal income growth forecast is a multiple of five. Once again, we find strong evidence in favor of our model mechanism: compared to consumers who do not round their reported income forecasts, rounders have significantly more countercyclical views of inflation.

We also consider a more granular rounding-based proxy for attention in the next set of coefficients (between the second and third red lines). Here we count the number of rounded forecasts for a given consumer's responses based on five questions: personal income growth, 1- and 5-year inflation expectations, and 1- and 5-year gas price expectations. We use all of these questions as they are the only numeric questions which have been asked over longer periods of time in the MSC. The downside is that our attention proxy is now a nonlinear transformation of the dependent variable we are interested in when estimating (33). Thus, compared to results based on personal income forecast rounding only, the interpretation of the magnitude of these estimates is more difficult. Nevertheless, we find an extremely strong relationship between the degree of rounding and the perceived countercyclicality of inflation across consumers. In all cases, a clear monotonically negative pattern emerges: consumers who round more often perceive inflation as significantly more countercyclical.

The final set of coefficients (below the third red line) is based on the attention proxy which compares phone-based and online interviews. Because the MSC only conducted simultaneous phone and online interviews during three months in 2024, our estimates are based on a few hundred observations and therefore much less precise than the previous estimates. However, consistent with our hypothesis, the point estimates for online respondents are more negative than for phone-based respondents across all measures of inflation expectations (though the difference is only statistically significant in some of the measures of inflation expectations).

Taking stock, using any of these proxies, we find robust evidence that consumers who are less attentive exhibit significantly stronger countercyclical perceptions of inflation. In Appendix Figure B7, we show that the patterns are the same when only focusing on college-educated respondents. We also construct similar attention proxies and estimate

(33) using the SCE. Appendix Figure B8 reports our estimated coefficients for inflation expectations (short- and longer-horizon in Panels A and B, and food and gas price expectations in Panels C and D). Note that the SCE did not undergo a methodological change in the format of the interview process, and price expectations for food and gas are only asked in follow-up interviews. However, we find very similar results to the MSC: consumers perceive inflation as more countercyclical in initial interviews (relative to follow-ups) or when they report rounded forecasts (relative to those who do not round).

6.2 Supply-Side Reasoning

Next, we test our second hypothesis that consumers whose reasoning emphasizes "supply-side" factors have stronger countercyclical perceptions of inflation. We do so by estimating (33) using proxies for "supply-side" reasoning. Our proxies are based on the set of questions in the MSC where respondents are asked to report open-ended reasons for their economic views. In particular, consumers are asked to report up to two different reasons regarding the change in their personal financial situation, overall forecasts for business conditions, and attitudes towards durable purchases, car purchases, and home purchases. The MSC then classifies these responses into a highly disaggregated set of approximately six hundred categories. We use the self-reported reasons in a similar way as recent papers such as Andre et al. (2023) who seek to better understand the "causal narratives" behind consumers' beliefs.

Because the responses are open-ended and categorized in such a highly disaggregated manner, using all responses without any additional structure is not feasible. We proceed using two different approaches. For the first approach, we manually classify responses into broader economic categories which can be more easily mapped to factors which can be thought of as more or less related to "aggregate supply" factors. Of course, it is not possible to map all responses into the two stylized factors of our model. Instead, we classify responses into ten categories. Our broad categories which we interpret as more clearly related to "supply-side" views are: *production/quality* (based on reasons related to firm production or the quality of firm products), *energy* (supply or prices of energy inputs), *labor relations* (wage demands by unions or the relationship between labor and management), and *prices* (changes in the price of goods themselves). In contrast, we interpret the following set of categories as less related to "supply-side" views: *consumer demand* (changes in overall consumer demand), *income/employment* (changes in wages, income, or employment), *credit/stocks* (credit or broader financial conditions), and *trade* (international competition). Our last set of broad categories which have more ambiguous relationships to "supply-side" views are: *taxes* (changes in overall or personal taxes), and *government* (other government-related reasoning). This last set is ambiguous because in principle we might expect these reasons to reflect fiscal shocks, but in practice the reasons reported by consumers in these categories are much more related to whether government policies or changes in taxes are helping or hurting business efficiency. All other reasons we classify as *none/other*.[24]

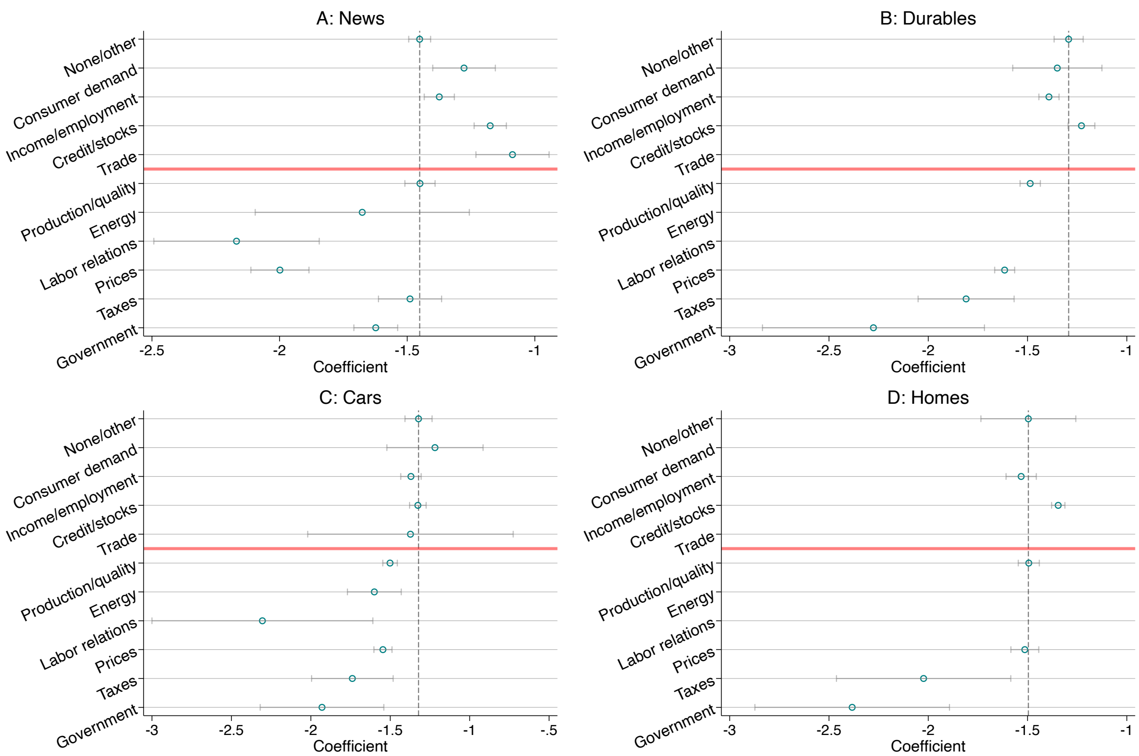

Figure 9: MSC Inflation Perceptions and Supply-Side Reasoning

Notes: estimates of (33) using different self-reported reason categories. Scatter points represent estimated interaction coefficients corresponding to the reason category described on the y-axis. Each panel corresponds to different choices of reasoning question: business conditions (Panel A), durable purchases (Panel B), car purchases (Panel C), or home purchases (Panel D). The solid red lines differentiates less vs. more (or ambiguous) supply-side reasoning (above and below, respectively). Horizontal lines represent 95% confidence intervals.

Figure 9 reports the estimates of (33) based on our reasoning classifications (with 1-year inflation expectations as the dependent variable). Panel A reports coefficient estimates using reasons related to business conditions (News), while Panels B through D

[24]Appendix C discusses our categorization and summarizes all MSC reason classifications.

use reasons related to durable, car, or home purchase attitudes (respectively).[25] It is important to note that we do not attempt to map each self-reported reason to some hypothetical model factor which can be cleanly categorized into "supply" or "demand" factors. Instead, our hypothesis is simply that consumers who report reasons more closely related to supply-side factors (production/quality, energy, labor relations, or prices) perceive inflation as more countercyclical compared to reasons that map less clearly to supply-side factors (none/other, consumer demand, income/employment, credit/stocks, or trade); our prediction regarding government policy reasons (taxes or government) is ambiguous. Consistent with our hypothesis, we see that the point estimates related to non-supply-side reasons (which are above the solid red line in each panel) are consistently less negative than those more closely aligned with supply-side factors. The results are strong for all categories besides home-buying attitudes (where we find similar estimates for supply-side and non-supply-side reasons). For instance, we see that consumers whose views about aggregate business conditions are shaped by reasons related to unions (labor relations) perceive inflation as more countercyclical than respondents who provide reasons related to consumer demand.[26]

Our findings are consistent with our hypothesis that consumers who emphasize supply-side factors as important drivers of their economic views believe that inflation is more strongly countercyclical. Appendix Figures B10, B11, and B12 show that this pattern holds for longer horizon inflation expectations and gas price expectations. These results also hold even based on secondary reported reasons (Appendix Figure B9).

The results of Figure 9 rely on manually classifying the underlying disaggregated MSC reasons. As an alternative, we instead conduct a factor analysis of the reported reasons. We include all reason responses in an MCA. Unsurprisingly, because there are approximately six hundred different open-ended "reason" categories across the different MSC questions, we find a more complicated factor structure than when only examining consumer forecasts. Panel A of Figure 10 shows that the first two factors explain over 20% and 10% of the variation in responses, respectively. The first factor is essentially a noisy replication of our baseline first factor (which can be seen in Appendix Figure B13). The second factor has a clear economic interpretation. Examining Panel B of Figure

[25] For durable and home attitudes, estimates are missing if there are not enough responses.

[26] Interestingly, we also find that consumers reporting government-related reasons tend to have stronger countercyclical perceptions of inflation; this is consistent with the interpretation that consumers view government policies as less related to standard theoretical fiscal (demand) shocks and instead as more relevant for promoting or hindering business efficiency. See Appendix C for all government-related reasoning in the MSC.

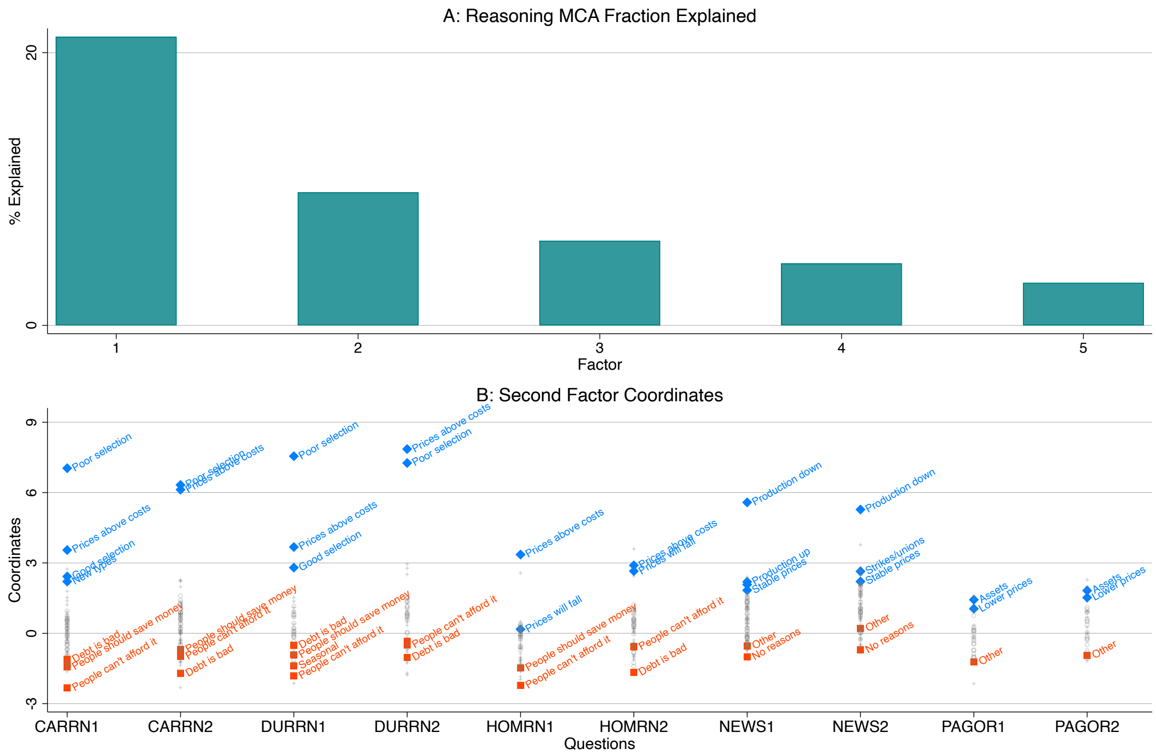

Figure 10: MSC Reasoning MCA Results

Notes: results of our estimated reasoning MCA. Panel A reports the fraction explained by the first five factors. Panel B reports the estimated loadings of the second factor. Blue scatter points correspond to frequently stated reasons for which we find a large positive loading in at least one of the reason questions, while red points are the same for negative loadings. Small gray '+' points represent infrequently cited reasons. Included questions: first and second reasons for car-buying attitudes (CARRN); durable-buying attitudes (DURRN); home-buying attitudes (HOMRN); reasons for beliefs about aggregate business conditions (NEWS); and reasons for beliefs about personal financial conditions.

10 which reports the estimated loadings of the second factor, we find that positive values are associated with clear supply-side reasoning. We highlight in blue any frequently cited reason across any of the included reason questions for which we estimate a positive loading. A clear pattern emerges: virtually all of the positive responses relate to (optimistic or pessimistic) views about the quality of goods, prices in relationship to costs of production, or reasons related to strikes. On the other hand, the red points highlight any frequently cited reason across any of the included reason question for which we estimate a negative loading. These reasons are instead more related to other reasons based on income, debt positions, or simply "no reasons given." We thus interpret the fitted second reason factor $\hat{r}_{i,t}$ as a proxy for the degree of "supply-side" reasoning of a given consumer.

Table 3: MSC Inflation Perceptions and Supply-Side Reason Factor

	(1)	(2)	(3)	(4)
$\hat{f}_{i,t}$	-1.404***	-0.737***	-6.941***	-14.107***
	(0.013)	(0.012)	(0.081)	(0.173)
$\hat{f}_{i,t} \times \hat{r}_{i,t}$	-0.088***	-0.018*	-1.492***	-1.513***
	(0.013)	(0.011)	(0.081)	(0.168)
R-sq	0.142	0.092	0.143	0.134
Obs.	298,691	227,166	175,962	197,386

Notes: estimates of $\hat{\beta}$ (first row) and $\hat{\eta}$ (second row) from (34). The interaction coefficient in the second row is based ont he interaction of our baseline fitted first component $\hat{f}_{i,t}$ (from Figure 2 and our second reason component $\hat{r}_{i,t}$ (from Figure 10). Each column corresponds to a different dependent variable: 1-year inflation expectations (1); 5-year inflation expectations (2); 1-year gas price expectations (3); 5-year gas price expectations (4).

We then estimate an alternative regression

$$\hat{\pi}_{i,t} = \beta \hat{f}_{i,t} + \eta \hat{f}_{i,t} \times \hat{r}_{i,t} + \gamma \mathbf{X}_{i,t} + \epsilon_{i,t}. \tag{34}$$

As in (33), the controls $\mathbf{X}_{i,t}$ include time fixed effects and the supply reason factor $\hat{r}_{i,t}$ directly. Our hypothesis is that consumers whose reasoning emphasizes supply factors have stronger countercyclical perceptions of inflation. This corresponds to $\hat{\eta} < 0$ (since from Figure 10, positive values of $\hat{r}_{i,t}$ are associated with more supply-side reasoning). Table 3 reports our results for 1-year inflation expectations (column 1), 5-year inflation expectations (column 2), 1-year gas price expectations (column 3), and 5-year gas price expectations (column 4). In all cases, we find a negative point estimate which are strongly statistically significant (besides 5-year inflation expectations which is only marginally significant). The economic magnitude is also relatively large compared to the baseline estimate of $\hat{\beta}$ (the first row of Table 3). Our results reinforce the findings based on manual classification of consumer reasoning: when consumers' self-reported reasoning emphasizes supply-side factors, their perception of inflation is more strongly countercyclical.

6.3 Aggregate Shocks

Finally, we test our third hypothesis that consumer beliefs react more strongly to aggregate supply factors compared to aggregate demand factors. Using our baseline component $\hat{f}_{i,t}$, we test whether consumer beliefs react more strongly to identified "supply" shocks compared to "demand" shocks. To do so, we draw on the empirical literature which has identified various aggregate shock series $\hat{s}_t$ and estimate

$$\hat{f}_{i,t+h} = \alpha^h + \beta^h \hat{s}_t + \gamma^h \mathbf{X}_{i,t} + \epsilon^h_{i,t}. \tag{35}$$

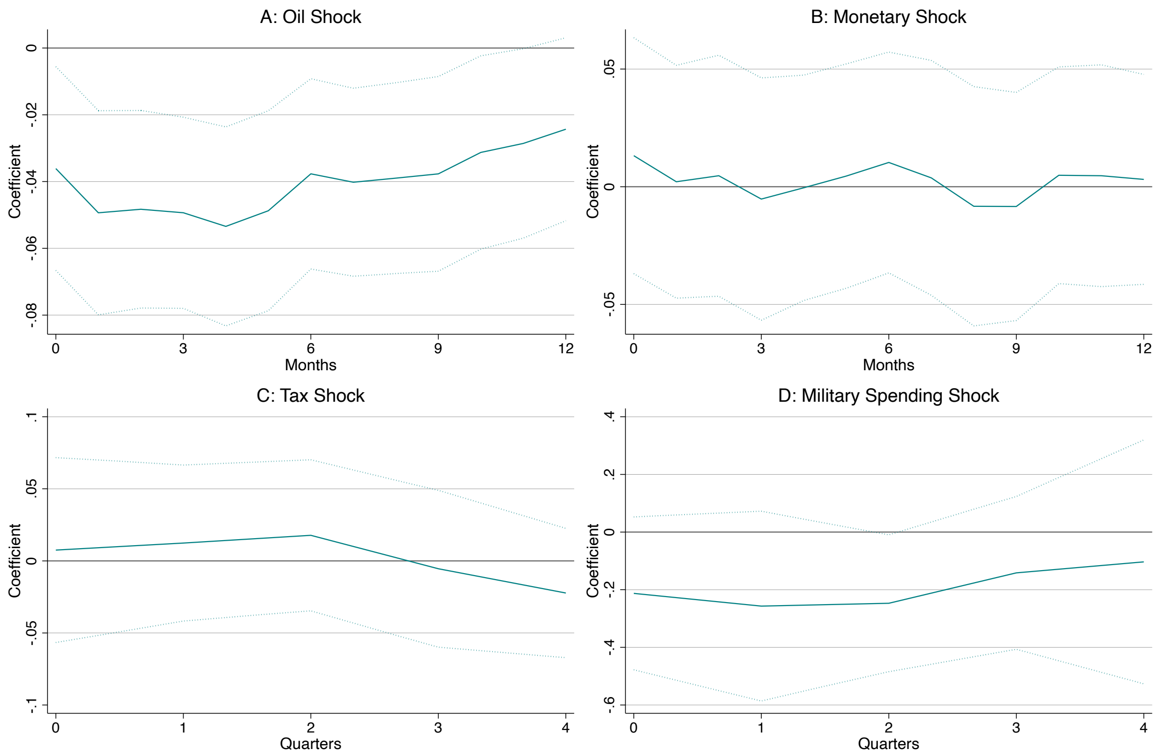

Figure 11: Consumer Belief Reactions to Supply and Demand Shocks

Notes: estimates of $\hat{\beta}^h$ from (35). Each panel corresponds to different shock series identified in the literature. A: oil shocks (Känzig 2021). B: monetary policy shocks (Nakamura and Steinsson 2018). C: tax shocks (Romer and Romer 2010). D: military spending shocks (Ramey and Zubairy 2018). Dotted lines represent 95% confidence intervals, clustered at the time level.

Figure 11 reports the results of our local projections. We include time fixed effects as well as lags of the shock variable. We estimate (35) in the cross-section and cluster standard errors at the time level, but results are highly similar if we aggregate consumer beliefs $\hat{f}_t$ and estimate (35) only in the time series (see Appendix Figure B14). We compare the reaction of consumer beliefs following oil shocks identified in Känzig (2021) (Panel A, which we classify as an aggregate supply shock) to monetary policy shocks from Nakamura and Steinsson (2018), tax shocks from Romer and Romer (2010), and military spending shocks from Ramey and Zubairy (2018) (Panels B, C, and D, which we classify as aggregate demand shocks). We include lags of the shock variable up to one year (12 lags for the monthly shocks series, and 4 lags for the quarterly time series). All shock series are normalized to have a mean of zero and unit standard deviation.

Our findings paint a clear picture. Following an unexpected increase in oil prices, consumer beliefs react strongly and immediately. Consumers become more pessimistic on impact and in the year following the oil price increase ($\hat{\beta}^h < 0$, which implies that $\hat{f}_{i,t}$ declines). The immediate decline remains similar in magnitude for at least six months, and statistically different from zero up until twelve months after the shock.

To interpret economic magnitudes, recall that $\hat{f}_{i,t}$ is constructed across both time and consumers and normalized to a standard deviation of one. However, a large portion of the variation is across consumers. Analyzing the time series variation (Appendix Figure B6), monthly swings in sentiment averaged over consumers $\bar{f}_t$ have a standard deviation of approximately 0.1. Thus, the economic magnitude of the response to oil shocks is relatively sizable as well: a standard deviation increase in the Känzig (2021) oil shock[27] implies a decline of 0.05, which is approximately half of a standard deviation of monthly changes in our measure of aggregate consumer sentiment.

Thus, consistent with our hypothesis, the results from Panel A show that consumer beliefs are highly reactive to aggregate supply shocks. In contrast, we find limited reaction of consumer beliefs to any of the aggregate demand shock series. Panels B, C, and D show that consumer beliefs have no statistically significant reaction at any point in the year following a shock to monetary policy, tax changes, or military spending shocks. The point estimates are also small for all of the shocks (besides military spending shocks in Panel D). It's important to note that for all of these shock series, the authors find statistically and economically significant reactions of either the real economy or asset prices. Thus, the lack of evidence for sizable consumer belief reactions to these demand-side shocks provides additional evidence in favor of our model mechanisms.

7 Concluding Remarks

Consumer beliefs about aggregate and personal economic conditions exhibit a low-dimension factor structure. One single component drives the vast majority of fluctuations in beliefs, and this factor seemingly acts like "sentiment." We rationalize this puzzling behavior in a New Keynesian model featuring rational inattention. Agents econ-

[27] A one-standard deviation Känzig (2021) shock leads to an increase in oil prices of approximately 5%, which is half a standard deviation of monthly oil price changes (West Texas Intermediate).

omize on information costs by obtaining a signal about a combination of both supply and demand shocks. For consumers relying on labor income, this information acquisition strategy typically implies higher precision in beliefs about supply-driven recessions and less about demand-driven recessions; thus, belief correlations differ in sign from the underlying data-generating process. The model shows the manner in which inattentive agents reduce the dimensionality of the problem; why they choose to learn about one component; how this leads to a counter-intuitive correlation of expectations in the cross-section; and how the aggregate dynamics of the model are affected by information frictions. We find strong empirical evidence supporting our theoretical mechanisms: the countercyclical perceptions of inflation found in consumer surveys are attention-driven and reflect a focus on aggregate supply factors and supply-side reasoning.

Appendix A Proofs

Proof of Proposition 1. Assuming Blanchard and Kahn (1980) determinacy conditions are met in (16), the unique rational expectations equilibrium is given by

$$\mathbf{x}_t = \mathbf{A}_x \mathbf{x}_{t-1} + \mathbf{C}_x \boldsymbol{\varepsilon}_t, \quad \mathbf{y}_t = \mathbf{A}_y \mathbf{x}_{t-1} + \mathbf{C}_y \boldsymbol{\varepsilon}_t. \tag{A1}$$

The dynamics matrices follow from the usual partitioning of the eigendecomposition $\tilde{\mathbf{A}} = \hat{\mathbf{V}}_t \mathbf{J}_t \mathbf{V}_t$: the diagonal matrices $\mathbf{J}_1, \mathbf{J}_2$ collect all eigenvalues inside and outside of the unit circle, respectively. Partition the matrices $\tilde{\mathbf{A}}, \tilde{\mathbf{C}}, \hat{\mathbf{V}}_t, \mathbf{V}_t$ accordingly, so the dynamics matrices in equations (A1) are given by $\mathbf{A}_y \equiv -\mathbf{V}_{22}^{-1}\mathbf{V}_{21}$, $\mathbf{C}_y \equiv -\mathbf{V}_{22}^{-1}\mathbf{J}_2^{-1}\left[\mathbf{V}_{21}\tilde{\mathbf{C}}_1 + \mathbf{V}_{22}\tilde{\mathbf{C}}_2\right]$, $\mathbf{A}_x \equiv \tilde{\mathbf{A}}_{11} + \tilde{\mathbf{A}}_{12}\mathbf{A}_y$, and $\mathbf{C}_x \equiv \tilde{\mathbf{C}}_1 + \tilde{\mathbf{A}}_{12}\mathbf{C}_y$. Hence, both $\mathbf{x}_{t-1}, \boldsymbol{\varepsilon}_t$ collected into the vector $\mathbf{X}_t$ evolve jointly according to (17). Then given a (time-invariant) signal of the form in (19), Kalman updating implies that (time-invariant) prior and posterior covariance matrices solve

$$\boldsymbol{\Sigma}_{1|1} = (\mathbf{I} - \mathbf{K}\mathbf{H})\,\boldsymbol{\Sigma}_{1|0}, \quad \boldsymbol{\Sigma}_{1|0} = \mathbf{A}\boldsymbol{\Sigma}_{1|1}\mathbf{A}^\top + \mathbf{C}\mathbf{C}^\top, \quad \mathbf{K} = \boldsymbol{\Sigma}_{1|0}\mathbf{H}^\top\left(\mathbf{H}\boldsymbol{\Sigma}_{1|0}\mathbf{H}^\top + \boldsymbol{\Sigma}_\eta\right)^{-1}, \tag{A2}$$

and state variables and posterior beliefs jointly evolve according to

$$\begin{bmatrix} \mathbf{X}_t \\ \hat{\mathbf{X}}_t^j \end{bmatrix} = \mathcal{A}\begin{bmatrix} \mathbf{X}_{t-1} \\ \hat{\mathbf{X}}_{t-1}^j \end{bmatrix} + \mathcal{C}\begin{bmatrix} \boldsymbol{\varepsilon}_t \\ \boldsymbol{\eta}_t^j \end{bmatrix}, \quad \mathcal{A} \equiv \begin{bmatrix} \mathbf{A} & \mathbf{0} \\ \mathbf{KHA} & (\mathbf{I} - \mathbf{KH})\,\mathbf{A} \end{bmatrix}, \quad \mathcal{C} \equiv \begin{bmatrix} \mathbf{C} & \mathbf{0} \\ \mathbf{KHC} & \mathbf{K} \end{bmatrix}. \tag{A3}$$

Given per-period quadratic utility in equation (18), certainty equivalence implies that the optimal action of agent j is a function of posterior beliefs: $\mathbf{a}_t^j \equiv -\frac{1}{2}\mathbf{B}_{aa}^{-1}\mathbf{B}_{xa}^\top \hat{\mathbf{X}}_t^j$. Then the problem of agent j is equivalent to minimizing losses due to misperceptions. Since $\beta^j = 0$, the problem is equivalent to the following repeated static optimization problem. Given a prior covariance $\mathbf{\Sigma}_{1|0}$ and defining $\mathbf{\Omega}$ as in (21), the problem is equivalent to picking a posterior covariance $\mathbf{\Sigma}$ to solve minimize $\operatorname{Tr}\mathbf{\Omega\Sigma} + \frac{1}{2}\mu\left(\operatorname{logdet}\mathbf{\Sigma}_{1|0} - \operatorname{logdet}\mathbf{\Sigma}\right)$, subject to the no-forgetting constraint $\mathbf{0} \preccurlyeq \mathbf{\Sigma} \preccurlyeq \mathbf{\Sigma}_{1|0}$ (as in Kőszegi and Matějka (2020) and Miao et al. (2022)). Using the cyclical properties of the trace operator, this is equivalent to solving

$$\min_{\tilde{\mathbf{\Sigma}}} \operatorname{Tr}\tilde{\mathbf{\Omega}}\tilde{\mathbf{\Sigma}} - \frac{1}{2}\mu \operatorname{logdet}\tilde{\mathbf{\Sigma}}, \quad \text{s.t. } \mathbf{0} \preccurlyeq \tilde{\mathbf{\Sigma}} \preccurlyeq \mathbf{I}, \tag{A4}$$

where $\tilde{\mathbf{\Omega}} = \mathbf{\Sigma}_{1|0}^{1/2}\mathbf{\Omega}\mathbf{\Sigma}_{1|0}^{1/2}$ $\tilde{\mathbf{\Sigma}} = \mathbf{\Sigma}_{1|0}^{-1/2}\mathbf{\Sigma}\mathbf{\Sigma}_{1|0}^{-1/2}$ (note Appendix D.2 shows that whenever $\mu > 0$, $\mathbf{\Sigma}_{1|0}^{-1/2}$ exists). The first-order conditions are therefore the same as in Kőszegi and Matějka (2020); the result follows.

For $\mathcal{H}$ households, $\operatorname{rank}\mathbf{\Omega} = 1$ (see Appendix D.3); Corollary 1.1 follows. □

Proof of Proposition 2. From equation (A3), long-run covariances of state and jump variables and posterior beliefs solve the following Lyapunov equation

$$\mathbb{V}ar\begin{bmatrix}\mathbf{X}_t \\ \hat{\mathbf{X}}_t\end{bmatrix} \equiv \mathcal{S} = \mathcal{A}\mathcal{S}\mathcal{A}^\top + \mathcal{C}\begin{bmatrix}\mathbf{I} & \mathbf{0} \\ \mathbf{0} & \mathbf{\Sigma}_\eta\end{bmatrix}\mathcal{C}^\top, \tag{A5}$$

and $\mathbf{\Sigma}_y = \begin{bmatrix}\mathbf{A}_y & \mathbf{C}_y\end{bmatrix}\mathbf{\Sigma}_X\begin{bmatrix}\mathbf{A}_y^\top \\ \mathbf{C}_y^\top\end{bmatrix}$, $\mathbf{\Sigma}_{\hat{y}} = \begin{bmatrix}\mathbf{A}_y & \mathbf{C}_y\end{bmatrix}\mathbf{\Sigma}_{\hat{X}}\begin{bmatrix}\mathbf{A}_y^\top \\ \mathbf{C}_y^\top\end{bmatrix}$. From (A3), unless $\mathbf{\Sigma}_\eta = \mathbf{0}$ and $\mathbf{KH} = \mathbf{I}$ (when all information frictions are eliminated so posterior beliefs $\hat{\mathbf{X}}_t^j \equiv \mathbf{X}_t$), we have $\mathbf{\Sigma}_X \neq \mathbf{\Sigma}_{\hat{X}}$ which also implies $\mathbf{\Sigma}_y \neq \mathbf{\Sigma}_{\hat{y}}$.

Let $N_1 \equiv \operatorname{rank}\mathbf{\Omega}$ and $N \equiv \dim\mathbf{X}_t$. First, from the proof of Prop. 1, the optimal signal structure implies $\mathbf{H\Sigma}_{1|0}\mathbf{H}^\top = \mathbf{I}_1$ (the identity matrix with dimension equal to N_1). Thus, $\mathbf{HK} = (\mathbf{I}_1 + \mathbf{\Sigma}_\eta)^{-1}$ and $\mathbf{KH} = \mathbf{\Sigma}_{1|0}^{1/2}\mathbf{U}_1\left(\mathbf{I}_1 + \mathbf{\Sigma}_\eta\right)^{-1}\mathbf{U}_1^\top\mathbf{\Sigma}_{1|0}^{-1/2}$. Thus we have that $\mathbf{KH} = \mathbf{I}$ (the identity matrix with dimension equal to J) iff $\mathbf{\Sigma}_\eta = \mathbf{0}$ and $\mathbf{U}_1\mathbf{U}_1^\top = \mathbf{I}$. The former condition does not hold whenever $\mu > 0$ (information costs are non-zero); the latter condition does not hold whenever $N_1 < N$ ($\mathbf{\Omega}$ is not full rank).

From equation (A5), posterior conditional covariances are $\check{\mathbf{\Sigma}}_{\hat{X}} = \mathcal{C}\begin{bmatrix}\mathbf{I} & \mathbf{0} \\ \mathbf{0} & \mathbf{\Sigma}_\eta\end{bmatrix}\mathcal{C}^\top$.

Since these covariances condition on $\mathbf{X}_{t-1}, \hat{\mathbf{X}}_{t-1}^{j}$, $\check{\boldsymbol{\Sigma}}_{\hat{X}}$ is all zeros besides the bottom-right block given by $\mathbf{K}\left[\mathbf{H}_{\epsilon}\mathbf{C}_{x}\mathbf{C}_{x}^{\top}\mathbf{H}_{\epsilon}^{\top}+\boldsymbol{\Sigma}_{\eta}\right]\mathbf{K}^{\top}$. This implies that jump posterior conditional covariances $\check{\boldsymbol{\Sigma}}_{\hat{y}} = \mathbf{C}_{y}\mathbf{K}\left[\mathbf{H}_{\epsilon}\mathbf{C}_{x}\mathbf{C}_{x}^{\top}\mathbf{H}_{\epsilon}^{\top}+\boldsymbol{\Sigma}_{\eta}\right]\mathbf{K}^{\top}\mathbf{C}_{y}^{\top}$. Because $\operatorname{rank}\mathbf{K} \leq N_1$, we also have that $\operatorname{rank}\check{\boldsymbol{\Sigma}}_{\hat{X}} \leq N_1$ and $\operatorname{rank}\check{\boldsymbol{\Sigma}}_{\hat{y}} \leq N_1$ for any $\mu > 0$.

Finally, when $\mathbf{A}_x = \mathbf{0}$, the state space is $\mathbf{X}_t \equiv \boldsymbol{\varepsilon}_t$, and further, $\boldsymbol{\Sigma}_{1|0} = \mathbf{C}\mathbf{C}^{\top} \equiv \mathbf{I}$. Thus when $N_1 = 1$ so the signal coefficient vector $\mathbf{h} \equiv \mathbf{u}_1^{\top}$ is one-dimensional, we have that $\boldsymbol{\Sigma}_{\hat{y}} = \check{\boldsymbol{\Sigma}}_{\hat{y}} \propto \mathbf{C}_y\mathbf{K}\mathbf{K}^{\top}\mathbf{C}_y^{\top} = \mathbf{C}_y\mathbf{h}^{\top}\mathbf{h}\mathbf{C}_y^{\top}$ (which follows because the gain vector $\mathbf{K} = \mathbf{h}^{\top}\cdot(1+\sigma_{\eta}^2)^{-1}$ is also one-dimensional). Any aggregate variable y_t can be written as a linear combination $\mathbf{c}\mathbf{X}_t$ for some row vector $\mathbf{c}$, and posterior beliefs also satisfy $\hat{y}_t^j = \mathbf{c}\hat{\mathbf{X}}_t^j$. Since $\mathbb{C}ov\left(\mathbf{c}\mathbf{X}_t, \mathbf{h}\mathbf{X}_t\right) = \mathbf{c}\boldsymbol{\Sigma}_{1|0}\mathbf{h}^{\top}$, this implies $\mathbb{C}ov\left(\mathbf{c}_1\hat{\mathbf{X}}_t^j, \mathbf{c}_2\hat{\mathbf{X}}_t^j\right) \propto \mathbf{c}_1\boldsymbol{\Sigma}_{1|0}\mathbf{h}^{\top}\mathbf{h}\boldsymbol{\Sigma}_{1|0}\mathbf{c}_2^{\top} = \mathbb{C}ov\left(\mathbf{c}_1\mathbf{X}_t, \mathbf{h}\mathbf{X}_t\right)\cdot\mathbb{C}ov\left(\mathbf{c}_2\mathbf{X}_t, \mathbf{h}\mathbf{X}_t\right)$. Then the results of Corollary 2.1 follow setting $\mathbf{h} = \mathbf{e}_k^{\top}$ for (i) and setting $\mathbf{c}_1 = \mathbf{h}$ for (ii). □

Proof of Proposition 3. Computing $\mathbb{C}ov(y_t, \pi_t)$ using equations (25) gives (26). From the proof of Prop. 2, we have that $\mathbb{C}ov(\hat{y}_t^j, \hat{\pi}_t^j) \propto \mathbb{C}ov(y_t, n_t^{\mathcal{H},*}) \cdot \mathbb{C}ov(\pi_t, n_t^{\mathcal{H},*})$. These covariances are given by (27), which follows since with iid dynamics, $n_t^{\mathcal{H},*} \propto \chi_n\tilde{\omega}_y y_t + (\chi_n\tilde{\omega}_{\gamma} - 1)\gamma_t$ (using the derivations in equations (D5)-(D12)).

If $\chi_n = 0$, then $n_t^{\mathcal{H},*} \propto -\gamma_t$ and so $\mathbb{C}ov(\hat{y}_t^j, \hat{\pi}_t^j) \propto C_{y,\gamma}C_{\pi,\gamma}\sigma_{\gamma}^2$. Hence if $C_{y,\gamma} < 0$ and $C_{\pi,\gamma} > 0$, $\mathbb{C}ov(\hat{y}_t^j, \hat{\pi}_t^j) < 0$ iff $\sigma_{\gamma}^2 > 0$. If $\chi_n \neq 0$, then if $\sigma_{\gamma}^2 = 0$, $\mathbb{C}ov(\hat{y}_t^j, \hat{\pi}_t^j) \propto C_{y,v}C_{\pi_v}\sigma_v^2$, which is positive if $C_{y,v} > 0$ and $C_{\pi,v} > 0$. Corollary 3.1 follows. □

Proof of Proposition 4. Taking first- and second- derivatives of (D5)-(D8) with respect to λ and $-K$ and evaluating at $\lambda = 0, K = 1$ gives results (i) and (ii). □

Proof of Proposition 5. The policy boosts output $\frac{\partial y_t}{\partial z_t} > 0 \iff \frac{\partial n_t^{\mathcal{H}}}{\partial z_t} > 0$. By assumption, $\frac{\partial \pi_t^j}{\partial z_t} > 0$. From the proof of Prop. 2, $\frac{\partial n_t^{\mathcal{H}}}{\partial z_t} > 0 \iff \mathbb{C}ov(\pi_t, n_t^{\mathcal{H},*}) > 0 \iff C_{\pi,v}\sigma_v^2 + \Xi C_{\pi,\gamma}\sigma_{\gamma}^2 > 0$, which follows from the proof of Prop. 3. □

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Online Appendix for “Attention-Driven Sentiment and the Business Cycle”

by Rupal Kamdar and Walker Ray

Appendix B Additional Figures and Tables

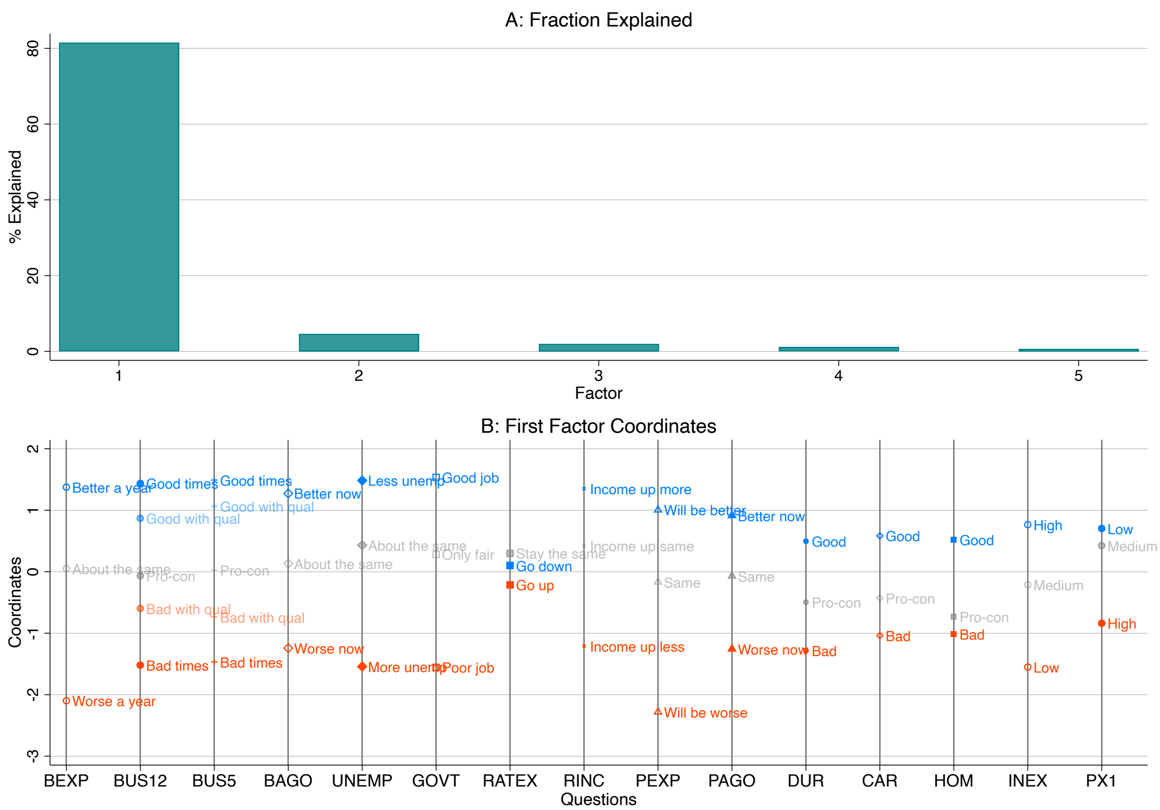

Figure B1: MSC MCA (with Inflation Expectations)

Notes: results for an alternative MCA estimates using the MSC. We additionally include numeric questions regarding inflation expectations and income expectations (PX1 and INEX); we include these responses in an MCA by binning into terciles. Panel A: fraction explained by the first five factors. Panel B: loadings from the first factor.

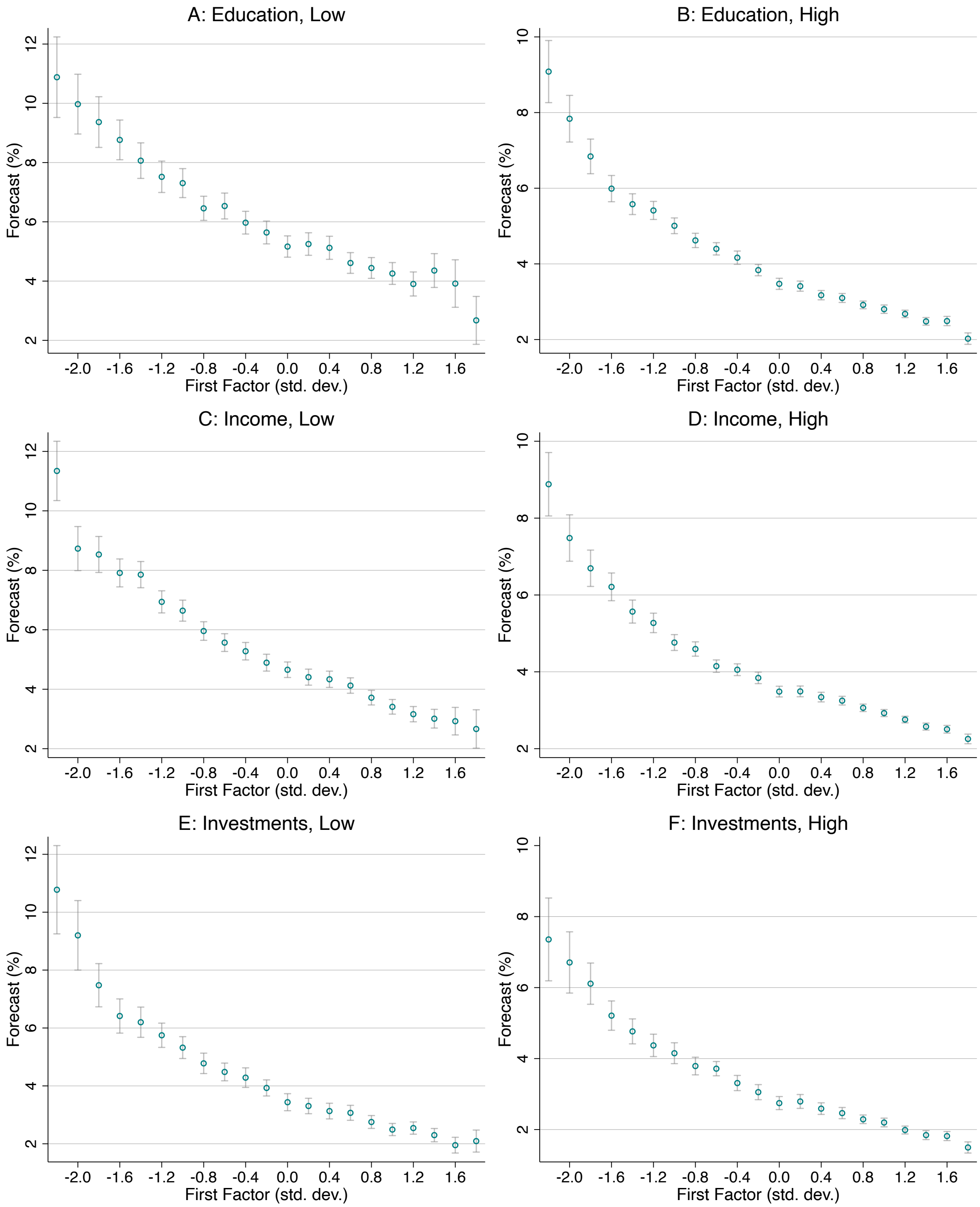

Figure B2: MSC MCA Factor and Inflation Expectations (Across Demographics)

Notes: estimated binned scatter plots as in Figure 3 across different demographics. Panels A and B: no college/college education. Panels C and D: bottom/top quintile of income. Panels E and F: bottom/top quintile of stock holdings. Vertical lines represent 95% confidence intervals.

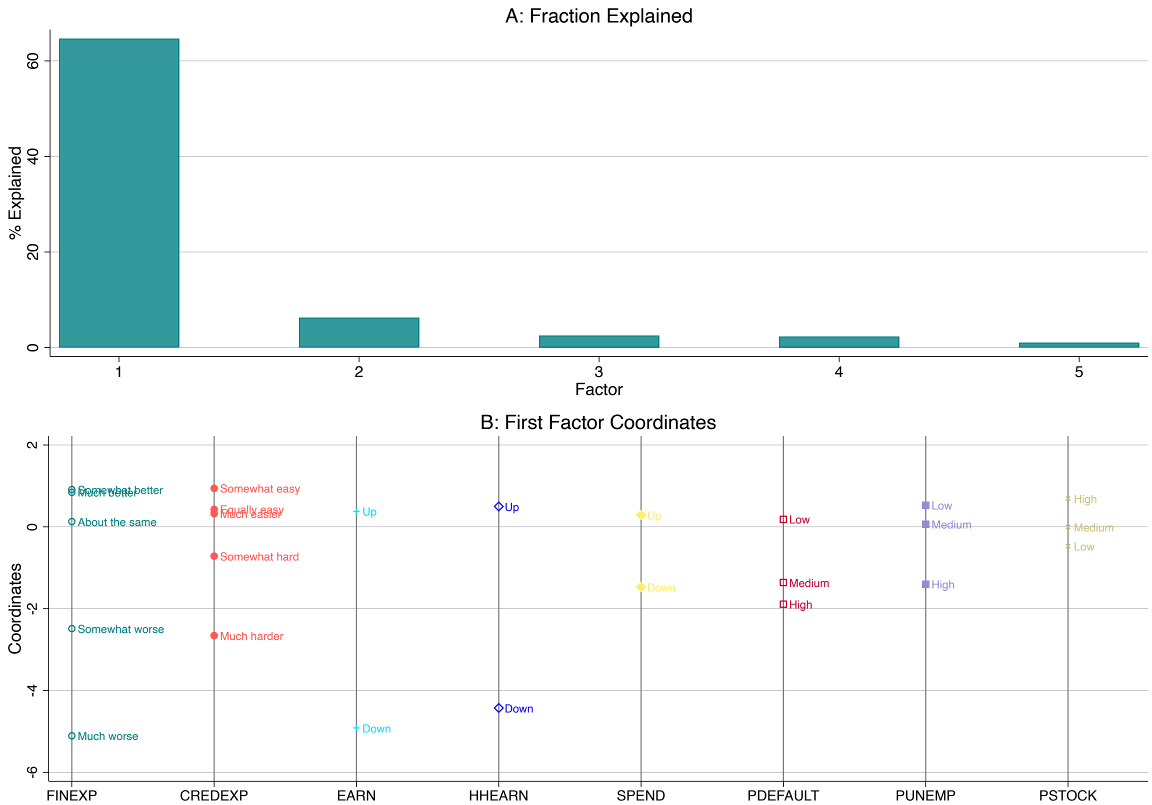

Figure B3: SCE MCA Results

Notes: results for our baseline MCA estimates using the SCE. Panel A: fraction explained by the first five factors. Panel B: loadings from the first factor. Each point on the x-axis corresponds to an included question; the scatter points represent the estimated loadings for each categorical response. Included questions: FINEXP: expectations of personal financial conditions. CREDEXP: expectations regarding ease of credit access. EARN: individual earnings expectations. HHEARN: total household earnings expectations. SPEND: total household consumption expectations. PDEFAULT: expectations regarding the probability of a personal default. PUNEMP: expectations regarding the probability of unemployment increasing. PSTOCK: expectations regarding the probability of stock returns increasing. Probability responses are binned into terciles.

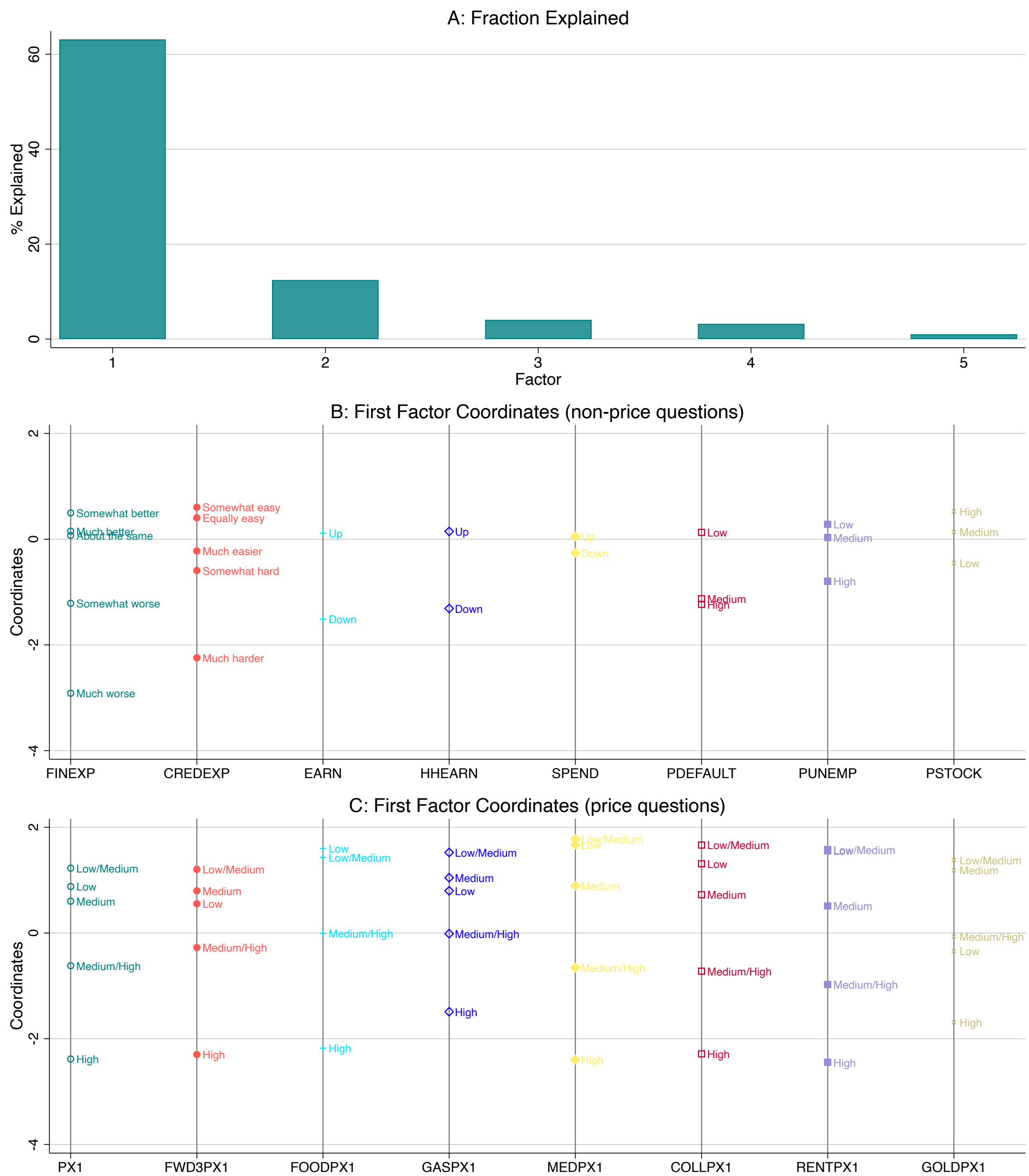

Figure B4: SCE MCA Results (with Price Questions)

Notes: results for an alternative MCA estimates using the SCE. Panel A: fraction explained by the first five factors. Panels B and C: loadings from the first factor. Each point on the x-axis corresponds to an included question; the scatter points represent the estimated loadings for each categorical response. Included questions: FINEXP: expectations of personal financial conditions. CREDEXP: expectations regarding ease of credit access. EARN: individual earnings expectations. HHEARN: total household earnings expectations. SPEND: total household consumption expectations. PDEFAULT: expectations regarding the probability of a personal default. PUNEMP: expectations regarding the probability of unemployment increasing. PSTOCK: expectations regarding the probability of stock returns increasing. PX1: 1-year inflation expectations. FWD3PX1: 3-year-ahead 1-year inflation expectations. FOODPX1: food price expectations. GASPX1: gas price expectations. MEDPX1: medical care price expectations. COLLPX1: college tuition expectations. RENTPX1: rental price expectations. GOLDPX1: gold price expectations. Probability responses are binned into terciles; price expectation questions are binned into quintiles.

Table B1: SCE MCA Summary

Panel A:	Baseline	
	(1)	(2)
Dim 1 %	64.7	63.1
Dim 2 %	6.2	12.4
Base Corr.		0.449
Obs.	113,642	98,430
Start Date	2013	2013
Panel B:	Education	
	(1)	(2)
Dim 1 %	55.1	66.9
Dim 2 %	9.2	6.3
Base Corr.	0.994	0.999
Obs.	10,393	69,673
Start Date	2013	2013
Panel C:	Income	
	(1)	(2)
Dim 1 %	61.0	66.1
Dim 2 %	6.7	7.1
Base Corr.	0.998	0.999
Obs.	29,569	41,559
Start Date	2013	2013
Panel D:	Age	
	(1)	(2)
Dim 1 %	62.9	63.6
Dim 2 %	6.8	6.0
Base Corr.	0.996	0.993
Obs.	42,195	17,356
Start Date	2013	2013

Notes: MCA results for the SCE. Panel A estimates various MCAs across all consumers, while Panels B, C, and D restrict the sample to different subgroups. The first column of Panel A estimates our baseline SCE MCA; included questions are described in Figure B3. Column (2) adds additional questions regarding price expectations (described in Figure B4). Panel B: high school/college educated. Panel C: income under 50k/over 100k. Panel D: age under 40/over 60.

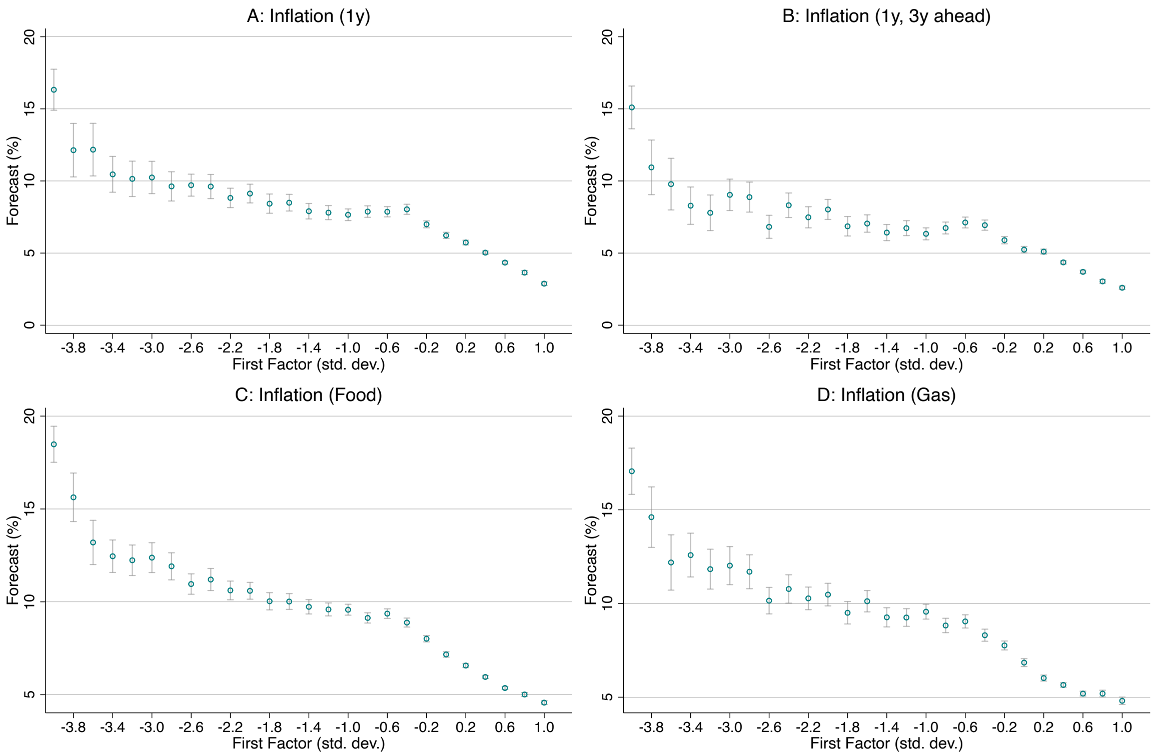

Figure B5: SCE MCA Factor and Inflation Expectations

Notes: estimated binned scatter plots as in Figure 3 using the SCE. Panel A: 1-year inflation expectations. Panel B: 3-year-ahead 1-year inflation expectations. Panel C: food price expectations. Panel D: gas price expectations. Vertical lines represent 95% confidence intervals.

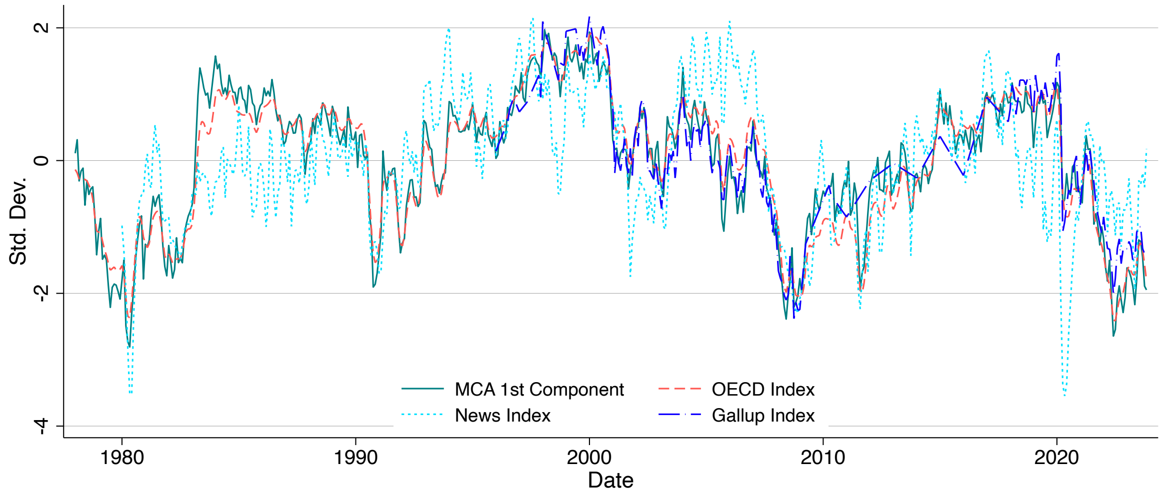

Figure B6: Comparison of MCA Component and Popular Indices of Sentiment

Notes: time-series comparison of different normalized measures of U.S. consumer sentiment and the average value of the fitted first component from our MCA analysis. The solid line represents the average value of our fitted first component (averaged over consumers in each month). The dashed line is the "Consumer confidence index" for the U.S. from the OECD. The dashed-dotted line is Gallup's "Economic Confidence Index." The dotted line is a "News Sentiment index" from Shapiro et al. (2022).

Table B2: SPF PCA Summary

	Dim 1	Dim 2	Dim 3	Dim 4
Nominal Growth (Next Quarter)	0.375	-0.079	-0.103	-0.119
Nominal Growth (Next Year)	0.321	0.067	-0.141	-0.281
Inflation (Next Quarter)	0.056	0.356	0.567	0.023
Inflation (Next Year)	0.071	0.370	0.558	0.020
Corporate Profit Growth (Next Quarter)	0.275	0.064	0.143	-0.297
Corporate Profit Growth (Next Year)	0.241	0.196	0.035	-0.393
Unemployment Change (Next Quarter)	-0.350	0.137	0.059	-0.197
Unemployment Change (Next Year)	-0.379	0.046	0.071	-0.153
Industrial Production Growth (Next Quarter)	0.385	-0.143	0.021	0.046
Industrial Production Growth (Next Year)	0.366	0.013	-0.044	-0.073
Housing Starts Growth (Next Quarter)	0.184	0.357	-0.192	0.486
Housing Starts Growth (Next Year)	0.079	0.449	-0.235	0.426
T-Bill Rate Change (Next Quarter)	0.098	-0.431	0.337	0.294
T-Bill Rate Change (Next Year)	0.131	-0.355	0.313	0.299
% Explained	35.091	15.616	13.263	10.497

Notes: SPF PCA estimates. The tables report the estimated loading for each forecast variable across the first four dimensions. The bottom row explains the fraction explained for the first four dimensions.

Table B3: SPF Psuedo MCA Summary

Panel A:			Dimension 1		
	(1)	(2)	(3)	(4)	(5)
Nominal Growth (Next Quarter)	1.79	0.72	0.04	-0.46	-1.89
Nominal Growth (Next Year)	1.65	0.85	-0.00	-0.51	-1.86
Inflation (Next Quarter)	0.54	0.18	-0.10	-0.23	-0.50
Inflation (Next Year)	0.78	0.10	0.05	-0.43	-0.71
Corporate Profit Growth (Next Quarter)	1.71	0.56	0.03	-0.80	-1.73
Corporate Profit Growth (Next Year)	1.64	0.52	-0.04	-0.68	-1.53
Unemployment Change (Next Quarter)	-1.89	-0.78	0.24	0.88	1.93
Unemployment Change (Next Year)	-2.24	-0.64	0.34	0.97	1.97
Industrial Production Growth (Next Quarter)	1.93	0.68	0.06	-0.71	-2.18
Industrial Production Growth (Next Year)	1.87	0.81	0.07	-0.78	-2.26
Housing Starts Growth (Next Quarter)	0.72	0.33	-0.21	-0.26	-0.68
Housing Starts Growth (Next Year)	0.39	0.20	-0.26	-0.22	-0.05
T-Bill Rate Change (Next Quarter)	0.71	0.19	0.25	0.01	-0.99
T-Bill Rate Change (Next Year)	1.05	0.44	0.14	-0.22	-1.31
Panel B:			Dimension 2		
	(1)	(2)	(3)	(4)	(5)
Nominal Growth (Next Quarter)	2.05	-0.62	-1.21	-0.96	1.01
Nominal Growth (Next Year)	2.29	-0.54	-0.99	-0.98	0.68
Inflation (Next Quarter)	0.61	-0.42	-0.52	-0.68	0.99
Inflation (Next Year)	0.80	-0.54	-0.76	-0.70	1.11
Corporate Profit Growth (Next Quarter)	1.18	-0.36	-0.99	-0.76	1.20
Corporate Profit Growth (Next Year)	1.52	-0.15	-0.78	-0.81	0.41
Unemployment Change (Next Quarter)	1.87	-0.78	-1.06	-0.75	1.60
Unemployment Change (Next Year)	1.49	-0.92	-1.05	-0.55	1.60
Industrial Production Growth (Next Quarter)	1.48	-0.89	-1.35	-0.92	1.73
Industrial Production Growth (Next Year)	1.63	-0.49	-1.27	-1.03	1.38
Housing Starts Growth (Next Quarter)	0.83	-0.50	-0.73	-0.33	0.96
Housing Starts Growth (Next Year)	1.07	-0.27	-0.47	-0.43	0.23
T-Bill Rate Change (Next Quarter)	-0.36	-0.95	-0.39	-0.14	1.59
T-Bill Rate Change (Next Year)	-0.03	-0.73	-0.28	-0.47	1.42
Panel C:			Fraction Explained		
	(1)	(2)	(3)	(4)	(5)
% Explained:	40.3	19.3	7.2	3.2	2.1

Notes: SPF “pseudo-MCA” estimates. We first convert the continuous responses in the SPF into quintiles. We then estimate an MCA using these categorical responses. Panel A reports the loadings of the first component for each question category, while Panel B reports the loadings of the second component. Panel C reports the fraction explained for the first five dimensions.

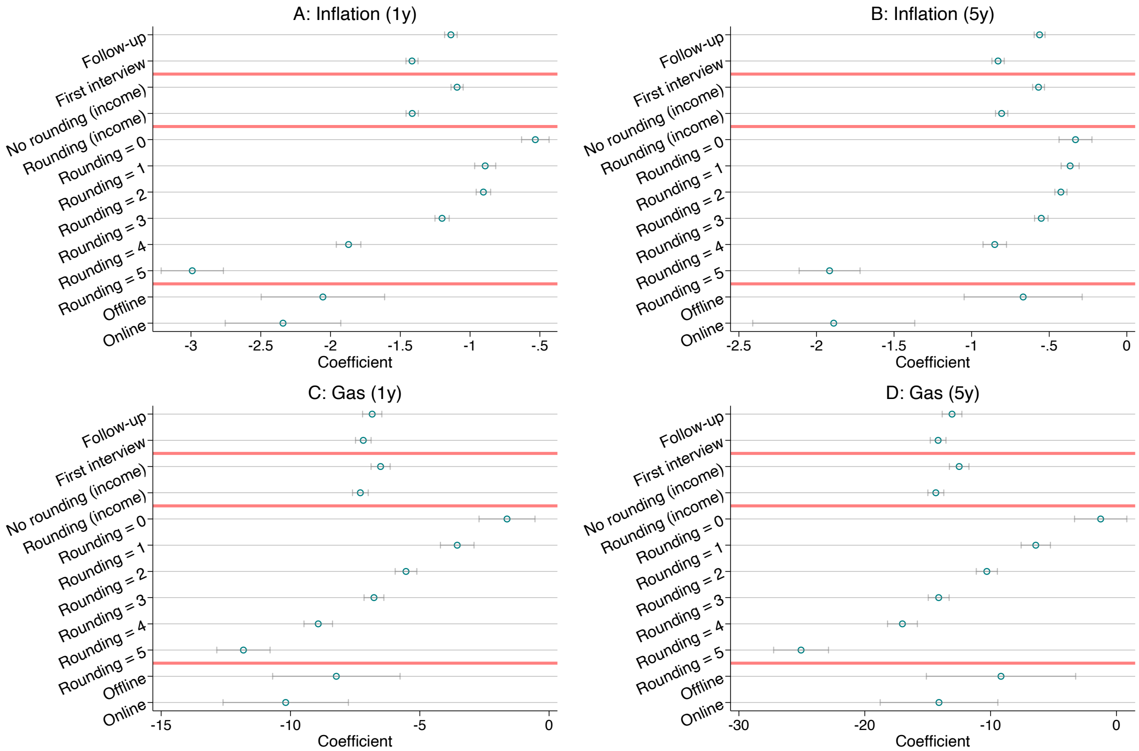

Figure B7: MSC Inflation and Attention (College-Educated)

Notes: estimates of (33) using proxies for attention as in Figure 8, but restricting the sample to consumers with a college education. Horizontal lines represent 95% confidence intervals.

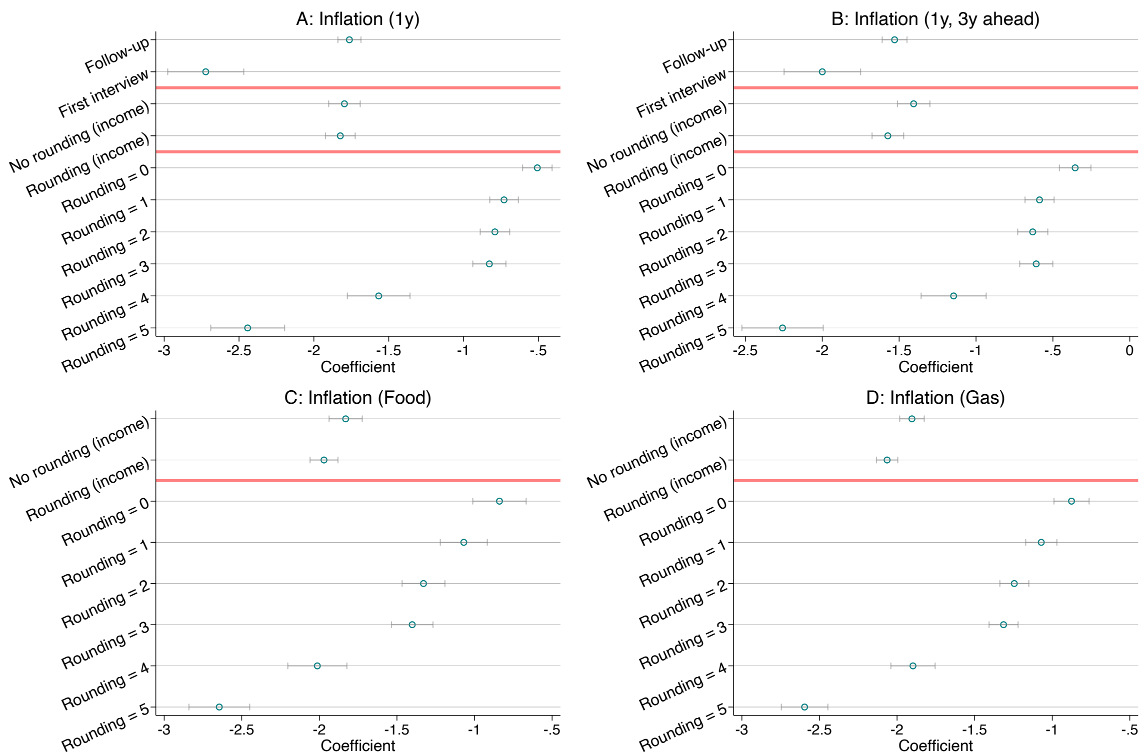

Figure B8: SCE Inflation and Attention

Notes: estimates of (33) using proxies for attention as in Figure 8, but based on SCE data. Horizontal lines represent 95% confidence intervals.

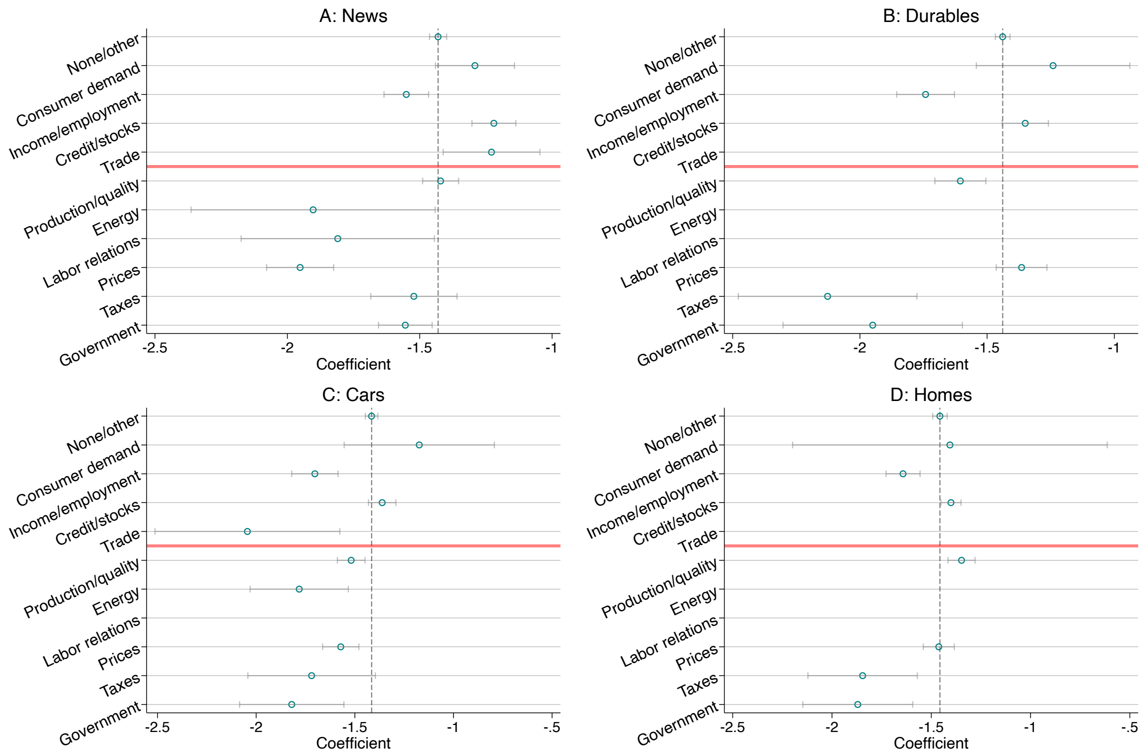

Figure B9: MSC Inflation Perceptions and Supply-Side Reasoning, Secondary

Notes: repeats the analysis of Figure 9, using the secondary reported reason. Horizontal lines represent 95% confidence intervals.

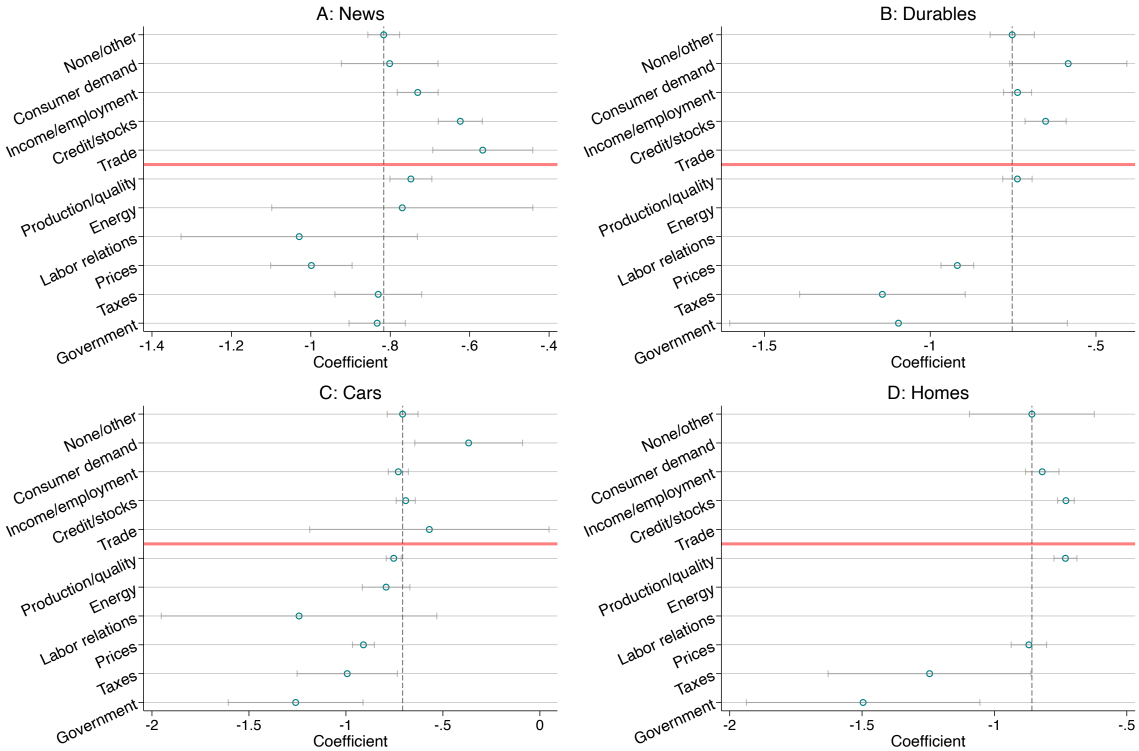

Figure B10: MSC Inflation Perceptions and Supply-Side Reasoning, 5-Year

Notes: repeats the analysis of Figure 9, using 5-year inflation expectations. Horizontal lines represent 95% confidence intervals.

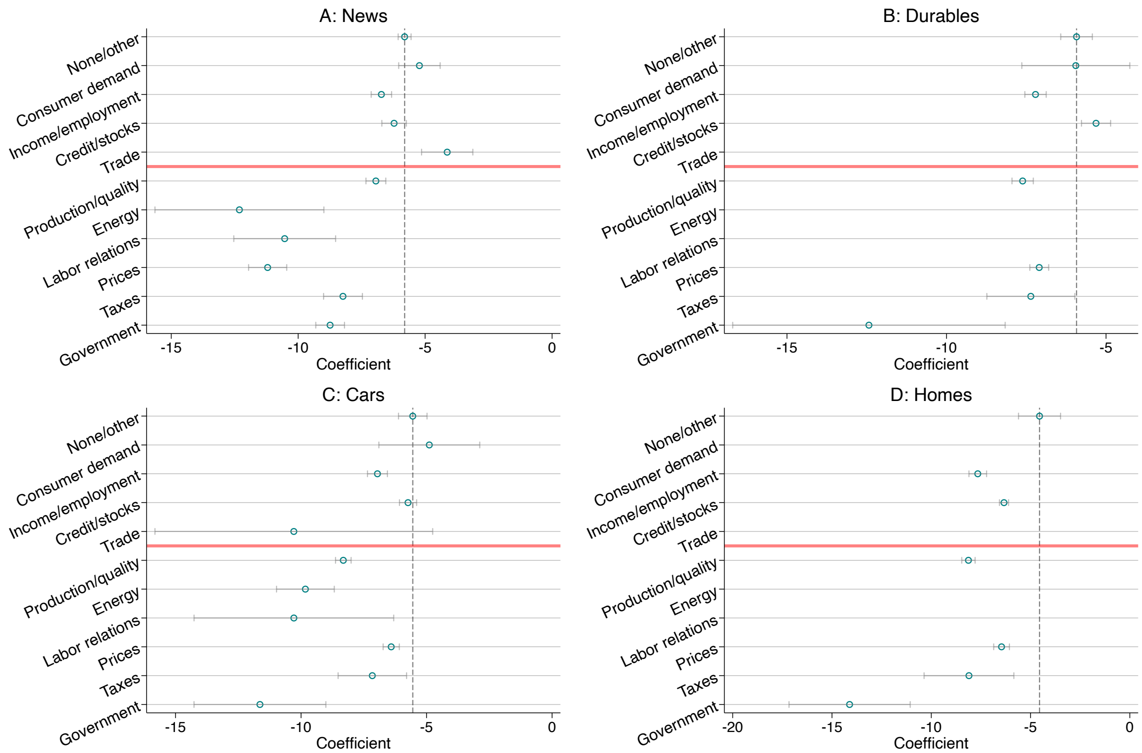

Figure B11: MSC Inflation Perceptions and Supply-Side Reasoning, 1-Year Gas

Notes: repeats the analysis of Figure 9, using 1-year gas price expectations. Horizontal lines represent 95% confidence intervals.

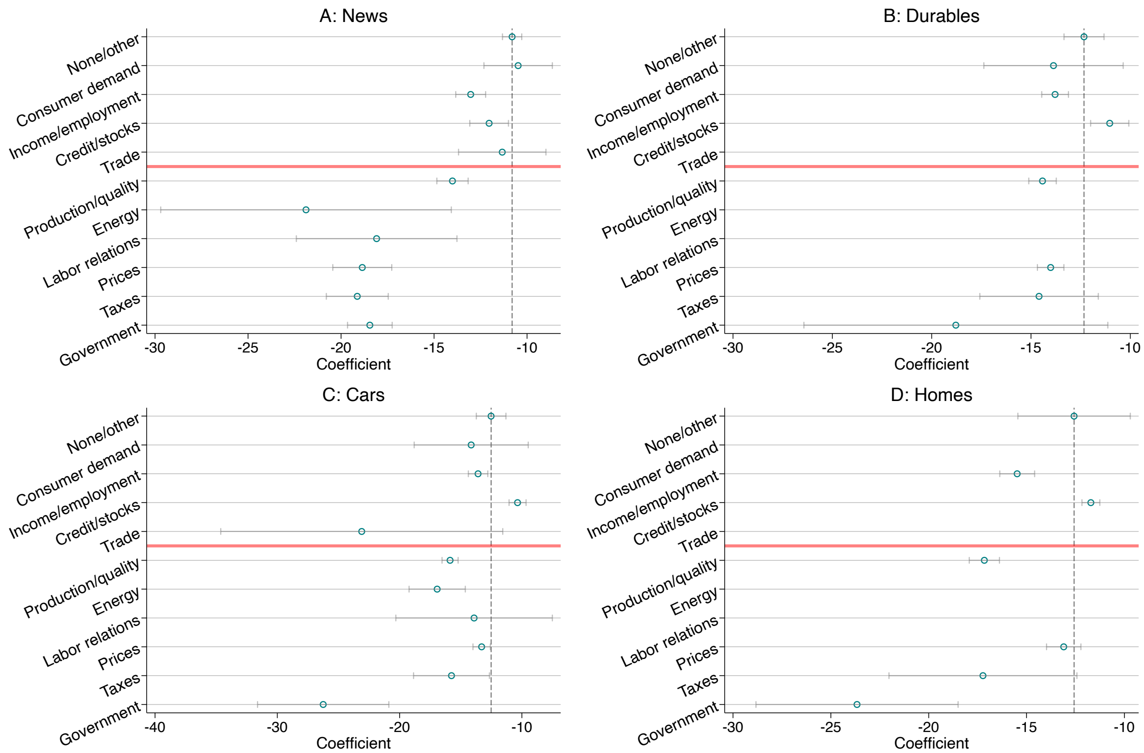

Figure B12: MSC Inflation Perceptions and Supply-Side Reasoning, 5-Year Gas

Notes: repeats the analysis of Figure 9, using 5-year gas price expectations. Horizontal lines represent 95% confidence intervals.

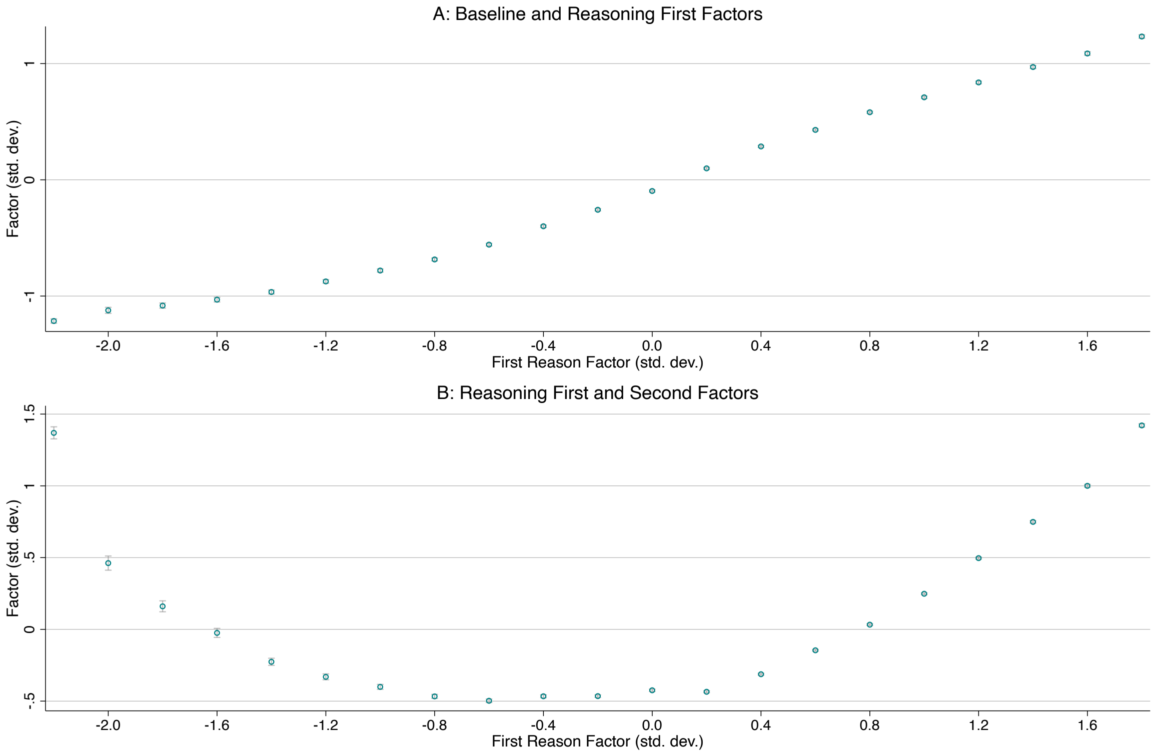

Figure B13: MSC MCA Reason Factors and Baseline Factor

Notes: estimated binned scatter plots comparing fitted factors from the reasoning question MCA and the baseline MCA (Figure 2). In each panel, the x-axis is the first fitted factor from the MCA estimated from reasoning questions. In Panel A, the y-axis is the baseline fitted first component. In Panel B, the y-axis is the fitted second component from the reason MCA. Vertical lines represent 95% confidence intervals.

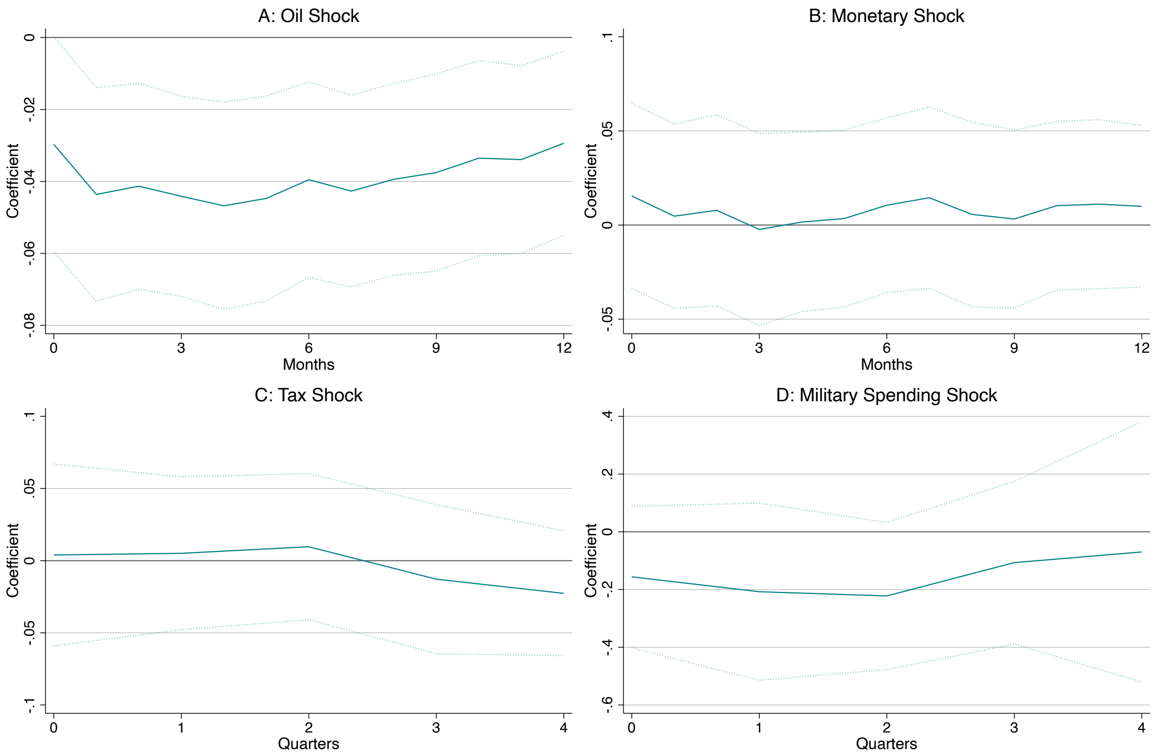

Figure B14: Consumer Belief Reactions to Supply and Demand Shocks

Notes: repeats the analysis of Figure 11 but estimated only using time-series variation in the fitted first factor $\bar{f}_t$. Dotted lines represent 95% confidence intervals.

Appendix C MSC Reasoning Categorization

This section provides details regarding the reasoning responses recorded in the Michigan Survey which we utilize in Section 6.2. The reasoning questions are as follows: CARRN1/CARRN2: reasons associated with car-buying attitudes (first and second reason); DURRN1/DURRN2: reasons associated with purchasing durable consumer goods (first and second reason); HOMRN1/HOMRN2: reasons associated with home-buying attitudes (first and second reason); NEWS1/NEWS2: reasons associated with perceptions of business conditions (first and second reason); PAGOR1/PAGOR2: reasons associated with personal financial conditions (first and second reason).

Tables C1-C10 provide summary tables for the classified reasoning responses in the MSC. The first two columns are the numeric code and description associated with the MSC's disaggregated reasoning categories for each question. The third column reports the mapping to our broad categories (see Section 6.2). The final column records the share of responses for each category.

Tables C11 and C12 report the estimated loadings of our reasoning MCA (see Figure 10).

For more information regarding the MSC reasoning classifications, see the codebooks from Survey of Consumers (2023).

Table C1: MSC Reasoning Summary: CARRN1

Code	Description	Category	Fraction
10	Interest rates won't get any lower (not...	Credit/stocks	0.1
11	Prices are low, lower; prices are reaso...	Prices	5.2
12	Good buys available; sales, discounts; ...	Production/quality	16.7
13	Prices are going up; buy before prices ...	Prices	7.0
14	Prices won't get any lower (not codeabl...	Prices	0.8
15	Lower down payment	Credit/stocks	0.1
16	Interest rates low	Credit/stocks	13.8
17	Credit easy to get; easy money, NA if 1...	Credit/stocks	0.6
18	Interest rates are going higher; credit...	Credit/stocks	0.9
19	Taxes low; will be higher (include exci...	Taxes	0.3
20	Rebate/Bonus program	None/other	1.7
21	People can afford to buy now; purchasin...	Income/employment	4.1
23	Buying makes for good times/prosperity/...	Consumer demand	0.6
25	Energy crisis lessened; availability of...	Energy	0.4
30	New cars get better mileage; better mil...	Production/quality	1.2
31	Supply adequate; no shortages now (no r...	Production/quality	0.7
32	Quality is good/better/may get worse	Production/quality	0.9
33	New models have improvements; new featu...	Production/quality	0.8
34	Great variety of models and sizes to ch...	Production/quality	0.2
35	(New) Small (economy) cars	Production/quality	0.7
36	Safety; new models are safer	Production/quality	0.2
37	Safety devices will be on and that's ba...	Production/quality	0.0
38	Anti-pollution devices (are or will be ...	Production/quality	0.0
39	Anti-pollution devices will be on and t...	Production/quality	0.0
40	Strikes ended: labor situation (problem...	Labor relations	0.0
41	Seasonal reference only	None/other	0.8
42	R only says that if you need it and hav...	None/other	3.3
43	Low sales won't last, will pick up soon...	None/other	0.1
44	NA whether 36 or 38, or both	Production/quality	0.0
45	NA whether 37 or 39, or both	Production/quality	0.0
46	New models are little changed from old ...	Production/quality	0.0
47	Other good reasons (miscellaneous)	None/other	0.9
49	Economic policy; references to governme...	Government	0.2
50	Interest rates won't get any lower	Credit/stocks	0.0
51	Prices are (too) high; prices going up;...	Prices	13.2
52	Seller's market; few sales or discounts...	Production/quality	2.6
53	Prices will fall later; are falling; wi...	Prices	0.6
54	Debt or credit is bad (NA why)	Credit/stocks	0.4
55	Larger/Higher down payment required	Credit/stocks	0.0
56	Interest rates are high; will go up	Credit/stocks	4.2
57	Credit hard to get; tight money, NA if ...	Credit/stocks	0.2
58	Interest rates will fall later; credit ...	Credit/stocks	0.1
59	Taxes high; going higher	Taxes	0.5
60	Because rebate/bonus program will be ov...	None/other	0.0
61	People can't afford to buy now (unemplo...	Income/employment	4.3
62	People should save money; uncertainty o...	Income/employment	2.8
63	Buying contributes to inflation, makes ...	Consumer demand	0.0
65	Energy crisis; gas shortage; price of g...	Energy	2.0
67	Environmental/Ecology reasons; pollutio...	Energy	0.1
70	Poor mileage (include poor mileage due ...	Production/quality	0.8
71	Supply inadequate; few cars on market; ...	Production/quality	1.0
72	Quality is poor; quality may be better ...	Production/quality	1.1
73	Poor designs; unattractive styling; new...	Production/quality	0.5
74	New types of cars will be introduced so...	Production/quality	0.5
75	New smaller cars	Production/quality	0.1
76	Safety; later models will be safer or c...	Production/quality	0.1
77	Too many safety items (unneeded, expens...	Production/quality	0.0
78	Later models will pollute less; polluti...	Production/quality	0.0
79	Anti-pollution devices (are or will be ...	Production/quality	0.1
80	Strikes; labor situation (problems), un...	Labor relations	0.1
81	R mentions only seasonal factors	None/other	0.2
82	Imported car market; international refe...	Trade	0.2
83	High sales can't last, change is due; s...	None/other	0.0
84	NA whether 76, or 78, or both	Production/quality	0.0
85	NA whether 77, or 79, or both	Production/quality	0.0
86	Poor performance, not clear whether due...	Production/quality	0.0
87	Other reasons why now is a bad time to ...	None/other	0.6
88	Cost of insurance	None/other	0.0
89	Economic policy; references to governme...	Government	0.2
90	Good for imported cars, bad for domesti...	None/other	0.0
91	Good time for new car, bad time for use...	None/other	0.1
92	Good time for used cars, bad time for n...	None/other	0.6
93	Depends on whether new or used; other c...	None/other	0.0
94	Good time for small cars, bad for big c...	None/other	0.1
95	Good time for big cars, bad for small c...	None/other	0.1
96	Good for domestic cars, bad for importe...	None/other	0.1

Table C2: MSC Reasoning Summary: CARRN2

Code	Description	Category	Fraction
0	No second mention	None/other	63.9
10	Interest rates won't get any lower (not...	Credit/stocks	0.0
11	Prices are low, lower; prices are reaso...	Prices	1.5
12	Good buys available; sales, discounts; ...	Production/quality	4.2
13	Prices are going up; buy before prices ...	Prices	1.3
14	Prices won't get any lower (not codeabl...	Prices	0.2
15	Lower down payment	Credit/stocks	0.2
16	Interest rates low	Credit/stocks	4.8
17	Credit easy to get; easy money, NA if 1...	Credit/stocks	0.5
18	Interest rates are going higher; credit...	Credit/stocks	0.6
19	Taxes low; will be higher (include exci...	Taxes	0.3
20	Rebate/Bonus program	None/other	0.9
21	People can afford to buy now; purchasin...	Income/employment	1.2
23	Buying makes for good times/prosperity/...	Consumer demand	0.4
25	Energy crisis lessened; availability of...	Energy	0.1
30	New cars get better mileage; better mil...	Production/quality	0.3
31	Supply adequate; no shortages now (no r...	Production/quality	0.3
32	Quality is good/better/may get worse	Production/quality	0.9
33	New models have improvements; new featu...	Production/quality	0.6
34	Great variety of models and sizes to ch...	Production/quality	0.2
35	(New) Small (economy) cars	Production/quality	0.2
36	Safety; new models are safer	Production/quality	0.1
37	Safety devices will be on and that's ba...	Production/quality	0.0
38	Anti-pollution devices (are or will be ...	Production/quality	0.0
39	Anti-pollution devices will be on and t...	Production/quality	0.0
40	Strikes ended: labor situation (problem...	Labor relations	0.0
41	Seasonal reference only	None/other	0.0
42	R only says that if you need it and hav...	None/other	0.0
43	Low sales won't last, will pick up soon...	None/other	0.1
44	NA whether 36 or 38, or both	Production/quality	0.0
45	NA whether 37 or 39, or both	Production/quality	0.0
46	New models are little changed from old ...	Production/quality	0.0
47	Other good reasons (miscellaneous)	None/other	0.9
49	Economic policy; references to governme...	Government	0.2
50	Interest rates won't get any lower	Credit/stocks	0.0
51	Prices are (too) high; prices going up;...	Prices	3.0
52	Seller's market; few sales or discounts...	Production/quality	0.9
53	Prices will fall later; are falling; wi...	Prices	0.4
54	Debt or credit is bad (NA why)	Credit/stocks	0.6
55	Larger/Higher down payment required	Credit/stocks	0.0
56	Interest rates are high; will go up	Credit/stocks	2.1
57	Credit hard to get; tight money, NA if ...	Credit/stocks	0.2
58	Interest rates will fall later; credit ...	Credit/stocks	0.1
59	Taxes high; going higher	Taxes	0.3
60	Because rebate/bonus program will be ov...	None/other	0.0
61	People can't afford to buy now (unemplo...	Income/employment	1.7
62	People should save money; uncertainty o...	Income/employment	1.0
63	Buying contributes to inflation, makes ...	Consumer demand	0.0
65	Energy crisis; gas shortage; price of g...	Energy	1.1
67	Environmental/Ecology reasons; pollutio...	Energy	0.1
70	Poor mileage (include poor mileage due ...	Production/quality	0.2
71	Supply inadequate; few cars on market; ...	Production/quality	0.7
72	Quality is poor; quality may be better ...	Production/quality	1.2
73	Poor designs; unattractive styling; new...	Production/quality	0.3
74	New types of cars will be introduced so...	Production/quality	0.1
75	New smaller cars	Production/quality	0.1
76	Safety; later models will be safer or c...	Production/quality	0.0
77	Too many safety items (unneeded, expens...	Production/quality	0.0
78	Later models will pollute less; polluti...	Production/quality	0.0
79	Anti-pollution devices (are or will be ...	Production/quality	0.0
80	Strikes; labor situation (problems), un...	Labor relations	0.0
81	R mentions only seasonal factors	None/other	0.0
82	Imported car market; international refe...	Trade	0.3
83	High sales can't last, change is due; s...	None/other	0.0
84	NA whether 76, or 78, or both	Production/quality	0.0
85	NA whether 77, or 79, or both	Production/quality	0.0
86	Poor performance, not clear whether due...	Production/quality	0.0
87	Other reasons why now is a bad time to ...	None/other	0.8
88	Cost of insurance	None/other	0.1
89	Economic policy; references to governme...	Government	0.4
90	Good for imported cars, bad for domesti...	None/other	0.0
91	Good time for new car, bad time for use...	None/other	0.0
92	Good time for used cars, bad time for n...	None/other	0.1
93	Depends on whether new or used; other c...	None/other	0.0
94	Good time for small cars, bad for big c...	None/other	0.0
95	Good time for big cars, bad for small c...	None/other	0.0
96	Good for domestic cars, bad for importe...	None/other	0.0

Table C3: MSC Reasoning Summary: DURRN1

Code	Description	Category	Fraction
10	Interest rates won't get any lower (not...	Credit/stocks	0.1
11	Prices are low(er); prices are reasonab...	Prices	10.6
12	Good buys available; sales, discounts; ...	Production/quality	19.6
13	Prices are going up; buy before prices ...	Prices	11.7
14	Prices won't get any lower (not codeabl...	Prices	1.6
15	Lower down payment	Credit/stocks	0.1
16	Interest rates low	Credit/stocks	6.2
17	Credit easy to get; easy money, NA if 1...	Credit/stocks	0.8
18	Interest rates going up; credit getting...	Credit/stocks	0.6
19	Low taxes; tax changes	Taxes	0.6
21	People can afford to buy now; purchasin...	Income/employment	6.0
23	Buying makes for good times/prosperity/...	Consumer demand	1.0
31	Supply adequate; no shortages now; ther...	Production/quality	0.4
32	Quality is good/better/may get worse	Production/quality	0.4
33	New models have improvements/new featur...	Production/quality	0.9
34	Good selection, variety	Production/quality	0.1
41	Seasonal references only	None/other	0.6
42	R only says that if you need it and/or ...	None/other	9.5
43	Low sales won't last; will pick up soon...	None/other	0.0
47	Other good reasons	None/other	1.0
49	Economic policy; references to governme...	Government	0.1
50	Interest rates won't get any lower (not...	Credit/stocks	0.0
51	Prices are (too) high: prices going up;...	Prices	7.4
52	Seller's market; few sales or discounts...	Production/quality	2.0
53	Prices will fall later, will come down,...	Prices	0.8
54	Debt or credit is bad (NA why)	Credit/stocks	0.9
55	Larger/Higher down payment required	Credit/stocks	0.0
56	Interest rates high/going up	Credit/stocks	2.3
57	Credit/Financing hard to get; tight mon...	Credit/stocks	0.2
58	Interest rates will fall later, credit ...	Credit/stocks	0.1
59	Taxes high, going higher	Taxes	0.3
61	People can't afford to buy now; low lev...	Income/employment	6.1
62	People should save money; uncertainty o...	Income/employment	5.4
63	Buying contributes to inflation, makes ...	Consumer demand	0.1
65	Energy crisis; shortages of fuels	Energy	0.0
71	Supply inadequate; poor selection (no r...	Production/quality	0.9
72	Quality is poor; quality may be better ...	Production/quality	0.4
73	Poor designs; unattractive styling; new...	Production/quality	0.2
81	R mentions only seasonal factors	None/other	0.5
82	International references	Trade	0.0
87	Other reasons why now is a bad time to ...	None/other	0.4
89	Economic policy; references to governme...	Government	0.1

Table C4: MSC Reasoning Summary: DURRN2

Code	Description	Category	Fraction
0	No second mention	None/other	76.7
10	Interest rates won't get any lower (not...	Credit/stocks	0.0
11	Prices are low(er); prices are reasonab...	Prices	1.5
12	Good buys available; sales, discounts; ...	Production/quality	2.4
13	Prices are going up; buy before prices ...	Prices	1.9
14	Prices won't get any lower (not codeabl...	Prices	0.2
15	Lower down payment	Credit/stocks	0.2
16	Interest rates low	Credit/stocks	2.2
17	Credit easy to get; easy money, NA if 1...	Credit/stocks	0.6
18	Interest rates going up; credit getting...	Credit/stocks	0.5
19	Low taxes; tax changes	Taxes	0.4
21	People can afford to buy now; purchasin...	Income/employment	1.6
23	Buying makes for good times/prosperity/...	Consumer demand	0.5
31	Supply adequate; no shortages now; ther...	Production/quality	0.2
32	Quality is good/better/may get worse	Production/quality	0.6
33	New models have improvements/new featur...	Production/quality	0.6
34	Good selection, variety	Production/quality	0.1
41	Seasonal references only	None/other	0.0
42	R only says that if you need it and/or ...	None/other	0.0
43	Low sales won't last; will pick up soon...	None/other	0.0
47	Other good reasons	None/other	0.9
49	Economic policy; references to governme...	Government	0.1
50	Interest rates won't get any lower (not...	Credit/stocks	0.0
51	Prices are (too) high: prices going up;...	Prices	1.2
52	Seller's market; few sales or discounts...	Production/quality	0.4
53	Prices will fall later, will come down,...	Prices	0.4
54	Debt or credit is bad (NA why)	Credit/stocks	0.9
55	Larger/Higher down payment required	Credit/stocks	0.0
56	Interest rates high/going up	Credit/stocks	1.0
57	Credit/Financing hard to get; tight mon...	Credit/stocks	0.1
58	Interest rates will fall later, credit ...	Credit/stocks	0.1
59	Taxes high, going higher	Taxes	0.2
61	People can't afford to buy now; low lev...	Income/employment	1.5
62	People should save money; uncertainty o...	Income/employment	1.2
63	Buying contributes to inflation, makes ...	Consumer demand	0.0
65	Energy crisis; shortages of fuels	Energy	0.0
71	Supply inadequate; poor selection (no r...	Production/quality	0.5
72	Quality is poor; quality may be better ...	Production/quality	0.6
73	Poor designs; unattractive styling; new...	Production/quality	0.1
81	R mentions only seasonal factors	None/other	0.0
82	International references	Trade	0.1
87	Other reasons why now is a bad time to ...	None/other	0.3
89	Economic policy; references to governme...	Government	0.3

Table C5: MSC Reasoning Summary: HOMRN1

Code	Description	Category	Fraction
10	Interest rate won't get any lower (not ...	Credit/stocks	0.4
11	Prices are low/lower/reasonable/stable/...	Prices	4.2
12	Good buys available; buyer's market (ov...	Production/quality	11.5
13	Prices are going up; buy before prices ...	Prices	5.1
14	Prices won't get any lower (not codeabl...	Prices	0.5
15	Lower down payment	Credit/stocks	0.1
16	Interest rates are low (now)	Credit/stocks	29.5
17	Credit easy to get; easy money, NA if 1...	Credit/stocks	0.6
18	Credit will be tighter later; interest ...	Credit/stocks	3.6
19	Lower taxes; taxes will be higher later...	Taxes	0.3
21	People can afford to buy now, purchasin...	Income/employment	2.8
23	Buying makes for good times/prosperity/...	Consumer demand	0.1
27	Other references to employment and purc...	None/other	0.0
31	Supply adequate, no shortages now; ther...	Production/quality	1.3
32	Quality is good, better, may get worse	Production/quality	0.0
33	New models have improvements/new featur...	Production/quality	0.0
34	Good selection; variety	Production/quality	0.0
41	Seasonal references only	None/other	0.1
42	R only says: If you need it and have th...	None/other	0.7
43	Low sales won't last; will pick up soon...	None/other	0.0
44	Renting is unfavorable because of high ...	Production/quality	0.3
45	Owning is always a good idea (because o...	Credit/stocks	2.2
46	Capital appreciation: buying a home is ...	Credit/stocks	1.3
47	Other good reasons (miscellaneous)	None/other	0.6
48	Variable mortgage rate	Credit/stocks	0.0
49	Economic policy; references to governme...	Government	0.1
50	Interest rates won't get any lower (not...	Credit/stocks	0.0
51	Prices are (too) high; prices going up;...	Prices	6.5
52	Seller's market, few sales or discounts...	Production/quality	4.7
53	Prices will fall later; will come down,...	Prices	1.0
54	Debt or credit bad (NA why)	Credit/stocks	0.2
55	Higher/Larger down payment required	Credit/stocks	0.2
56	Interest rate too high; will go up	Credit/stocks	11.7
57	Credit hard to get; financing is diffic...	Credit/stocks	0.7
58	Interest rates will come down later; cr...	Credit/stocks	0.6
59	Tax increase; (property) taxes too high...	Taxes	0.3
61	People can't afford to buy now (unemplo...	Income/employment	4.9
62	People should save money; uncertainty o...	Income/employment	2.3
63	Buying contributes to inflation/makes f...	Consumer demand	0.0
65	Energy crisis; shortages of fuels; high...	Energy	0.0
71	Supply inadequate; few houses on market...	Production/quality	0.1
72	Quality is poor; quality may be better ...	Production/quality	0.1
73	Poor designs; unattractive styling; new...	Production/quality	0.0
81	R mentions only seasonal factors	None/other	0.1
82	Difficult to get rid of present house	None/other	0.1
83	Better return on alternative investment...	Credit/stocks	0.0
84	Renting favorable because of low rents ...	Production/quality	0.0
85	Renting is always better than owning	None/other	0.0
86	Capital depreciation: buying a house no...	Credit/stocks	0.3
87	Other reasons why now is a bad time to ...	None/other	0.3
88	Variable mortgage rate	Credit/stocks	0.0
89	Economic policy; references to governme...	Government	0.3

Table C6: MSC Reasoning Summary: HOMRN2

Code	Description	Category	Fraction
0	No second mention	None/other	52.2
10	Interest rate won't get any lower (not ...	Credit/stocks	0.2
11	Prices are low/lower/reasonable/stable/...	Prices	2.5
12	Good buys available; buyer's market (ov...	Production/quality	5.2
13	Prices are going up; buy before prices ...	Prices	2.4
14	Prices won't get any lower (not codeabl...	Prices	0.2
15	Lower down payment	Credit/stocks	0.1
16	Interest rates are low (now)	Credit/stocks	6.4
17	Credit easy to get; easy money, NA if 1...	Credit/stocks	1.1
18	Credit will be tighter later; interest ...	Credit/stocks	2.3
19	Lower taxes; taxes will be higher later...	Taxes	0.5
21	People can afford to buy now, purchasin...	Income/employment	2.4
23	Buying makes for good times/prosperity/...	Consumer demand	0.2
27	Other references to employment and purc...	None/other	0.0
31	Supply adequate, no shortages now; ther...	Production/quality	1.8
32	Quality is good, better, may get worse	Production/quality	0.1
33	New models have improvements/new featur...	Production/quality	0.0
34	Good selection; variety	Production/quality	0.1
41	Seasonal references only	None/other	0.0
42	R only says: If you need it and have th...	None/other	0.0
43	Low sales won't last; will pick up soon...	None/other	0.0
44	Renting is unfavorable because of high ...	Production/quality	0.4
45	Owning is always a good idea (because o...	Credit/stocks	1.6
46	Capital appreciation: buying a home is ...	Credit/stocks	1.4
47	Other good reasons (miscellaneous)	None/other	0.7
48	Variable mortgage rate	Credit/stocks	0.0
49	Economic policy; references to governme...	Government	0.2
50	Interest rates won't get any lower (not...	Credit/stocks	0.0
51	Prices are (too) high; prices going up;...	Prices	3.0
52	Seller's market, few sales or discounts...	Production/quality	1.4
53	Prices will fall later; will come down,...	Prices	1.0
54	Debt or credit bad (NA why)	Credit/stocks	0.3
55	Higher/Larger down payment required	Credit/stocks	0.4
56	Interest rate too high; will go up	Credit/stocks	3.5
57	Credit hard to get; financing is diffic...	Credit/stocks	0.8
58	Interest rates will come down later; cr...	Credit/stocks	0.3
59	Tax increase; (property) taxes too high...	Taxes	0.4
61	People can't afford to buy now (unemplo...	Income/employment	3.0
62	People should save money; uncertainty o...	Income/employment	1.6
63	Buying contributes to inflation/makes f...	Consumer demand	0.0
65	Energy crisis; shortages of fuels; high...	Energy	0.0
71	Supply inadequate; few houses on market...	Production/quality	0.3
72	Quality is poor; quality may be better ...	Production/quality	0.2
73	Poor designs; unattractive styling; new...	Production/quality	0.0
81	R mentions only seasonal factors	None/other	0.0
82	Difficult to get rid of present house	None/other	0.1
83	Better return on alternative investment...	Credit/stocks	0.0
84	Renting favorable because of low rents ...	Production/quality	0.0
85	Renting is always better than owning	None/other	0.0
86	Capital depreciation: buying a house no...	Credit/stocks	0.3
87	Other reasons why now is a bad time to ...	None/other	0.5
88	Variable mortgage rate	Credit/stocks	0.0
89	Economic policy; references to governme...	Government	0.5

Table C7: MSC Reasoning Summary: NEWS1

Code	Description	Category	Fraction
0	Has heard of no changes; no second ment...	None/other	38.4
10	Recent or upcoming elections; new admin...	Government	0.5
11	More defense/military spending or produ...	Government	0.1
12	Less defense/military spending or produ...	Government	0.1
13	Specific government spending programs r...	Government	0.0
14	Specific government spending programs, ...	Government	0.1
15	Specific government spending programs e...	Government	0.0
16	Taxes: tax changes/reforms; tax rebate...	Taxes	0.7
17	Other references to government	Government	0.0
18	Fiscal policy general; budgets; deficit...	Government	0.1
19	Government/Congress/Administration/Pres...	Government	0.9
20	Opening of plants and factories (govern...	Production/quality	1.1
21	Consumer or auto demand is (will be) hi...	Consumer demand	1.3
22	Purchasing power is (will be) high; peo...	Income/employment	0.4
23	Employment has risen/is rising; more ov...	Income/employment	4.1
24	Population increase; more people to buy...	Income/employment	0.0
25	Low (lower) debts; high (higher) assets...	Credit/stocks	0.1
27	Other references to employment and purc...	None/other	0.1
28	Production is increasing/is high; GNP i...	Production/quality	0.4
29	Unemployment has risen/will rise (and t...	Income/employment	0.1
30	Tight money; interest rates high; credi...	Credit/stocks	0.2
31	Lower or stable prices; prices won't ri...	Prices	0.9
32	High(er) prices; inflation; prices will...	Prices	0.1
33	Easier money; credit easy to get; lower...	Credit/stocks	2.1
35	Profits high/rising	Production/quality	0.3
36	Stock market; rise in price of stocks	Credit/stocks	1.8
37	Other references to prices/credit	None/other	0.0
38	Balance of payments; world monetary sit...	Trade	0.4
39	Controls (price and/or wage)	Government	0.0
40	Better race relations; less racial unre...	None/other	0.0
41	Union disputes/strikes have been (will ...	Labor relations	0.1
42	Times are (business is) good now and wo...	None/other	0.2
43	Bad times can't last; we are due for go...	None/other	0.0
44	R sees signs of improvement already; R ...	None/other	1.2
45	Improvements in specific industries; pr...	Production/quality	3.2
46	Farm situation good; crops good	Production/quality	0.1
47	Other good factors or favorable referen...	None/other	0.7
48	Economy in general more stable/under co...	Consumer demand	0.3
49	Energy crisis lessened, less depletion ...	Energy	0.1
50	Recent or upcoming elections; new admin...	Government	0.7
51	More defense/military spending or produ...	Government	0.5
52	Less defense/military spending or produ...	Government	0.1
53	Specific government spending programs r...	Government	0.0
54	Specific government spending programs e...	Government	0.3
55	Specific government spending programs b...	Government	0.1
56	Taxes: tax changes/reforms; tax rebate...	Taxes	1.5
57	Other references to government	Government	0.1
58	Fiscal policy general; budgets; deficit...	Government	0.4
59	Government/Congress/Administration/Pres...	Government	1.8
60	Closing of plants and factories (genera...	Production/quality	4.8
61	Consumer or auto demand is (will be) lo...	Consumer demand	1.7
62	Lack of purchasing power; people don't ...	Income/employment	0.6
63	Drop in employment (except 60); high or...	Income/employment	7.8
64	Population increase; immigration	Income/employment	0.1
65	High (higher) debts; lower assets/savin...	Credit/stocks	0.3
67	Other references to employment and purc...	None/other	0.1
68	Production decreasing; production is lo...	Production/quality	0.5
69	Real estate/housing market in decline; ...	Credit/stocks	0.5
70	Financial crisis; financial institution...	Credit/stocks	0.1
71	Prices are falling/will fall/are too lo...	Prices	0.1
72	Prices are high, are rising, inflation;...	Prices	3.7
73	Tight money; credit hard to get; intere...	Credit/stocks	2.6
74	Profits low, falling	Production/quality	0.2
75	Profits high; too high	Production/quality	0.1
76	Stock market references; decline in pri...	Credit/stocks	2.1
77	Other price/credit references	None/other	0.1
78	Balance of payments; foreign competitio...	Trade	1.3
79	Controls (price and/or wage)	Government	0.0
80	Bad race relations; racial unrest; riot...	None/other	0.1
81	Excessive wage or other demands by unio...	Labor relations	0.6
82	Times are (business is) bad now and won...	None/other	0.2
83	Good times can't last–we are due for a...	None/other	0.0
84	R sees signs of downward trend in busin...	None/other	1.0
85	Decline in specific industries; problem...	Production/quality	3.6
86	Farm situation is bad; drought; low far...	Production/quality	0.4
87	Other unfavorable or bad factors (inclu...	None/other	0.9
88	Economy in general less stable/not unde...	Consumer demand	0.2
89	Energy crisis; depletion of natural res...	Energy	0.4
90	Business/Accounting scandals	Credit/stocks	0.2
97	Change mentioned but NA whether favorab...	None/other	0.1

Table C8: MSC Reasoning Summary: NEWS2

Code	Description	Category	Fraction
0	Has heard of no changes; no second ment...	None/other	63.6
10	Recent or upcoming elections; new admin...	Government	0.2
11	More defense/military spending or produ...	Government	0.0
12	Less defense/military spending or produ...	Government	0.0
13	Specific government spending programs r...	Government	0.0
14	Specific government spending programs, ...	Government	0.1
15	Specific government spending programs e...	Government	0.0
16	Taxes: tax changes/reforms; tax rebate...	Taxes	0.4
17	Other references to government	Government	0.0
18	Fiscal policy general; budgets; deficit...	Government	0.1
19	Government/Congress/Administration/Pres...	Government	0.5
20	Opening of plants and factories (govern...	Production/quality	0.5
21	Consumer or auto demand is (will be) hi...	Consumer demand	0.6
22	Purchasing power is (will be) high; peo...	Income/employment	0.4
23	Employment has risen/is rising; more ov...	Income/employment	1.5
24	Population increase; more people to buy...	Income/employment	0.0
25	Low (lower) debts; high (higher) assets...	Credit/stocks	0.1
27	Other references to employment and purc...	None/other	0.0
28	Production is increasing/is high; GNP i...	Production/quality	0.3
29	Unemployment has risen/will rise (and t...	Income/employment	0.0
30	Tight money; interest rates high; credi...	Credit/stocks	0.1
31	Lower or stable prices; prices won't ri...	Prices	0.6
32	High(er) prices; inflation; prices will...	Prices	0.0
33	Easier money; credit easy to get; lower...	Credit/stocks	0.8
34	Crowd funding	Credit/stocks	0.0
35	Profits high/rising	Production/quality	0.2
36	Stock market; rise in price of stocks	Credit/stocks	0.9
37	Other references to prices/credit	None/other	0.0
38	Balance of payments; world monetary sit...	Trade	0.2
39	Controls (price and/or wage)	Government	0.0
40	Better race relations; less racial unre...	None/other	0.0
41	Union disputes/strikes have been (will ...	Labor relations	0.1
42	Times are (business is) good now and wo...	None/other	0.1
43	Bad times can't last; we are due for go...	None/other	0.0
44	R sees signs of improvement already; R ...	None/other	1.0
45	Improvements in specific industries; pr...	Production/quality	2.7
46	Farm situation good; crops good	Production/quality	0.0
47	Other good factors or favorable referen...	None/other	0.6
48	Economy in general more stable/under co...	Consumer demand	0.2
49	Energy crisis lessened, less depletion ...	Energy	0.1
50	Recent or upcoming elections; new admin...	Government	0.4
51	More defense/military spending or produ...	Government	0.4
52	Less defense/military spending or produ...	Government	0.1
53	Specific government spending programs r...	Government	0.0
54	Specific government spending programs e...	Government	0.2
55	Specific government spending programs b...	Government	0.1
56	Taxes: tax changes/reforms; tax rebate...	Taxes	0.8
57	Other references to government	Government	0.1
58	Fiscal policy general; budgets; deficit...	Government	0.4
59	Government/Congress/Administration/Pres...	Government	1.0
60	Closing of plants and factories (genera...	Production/quality	1.6
61	Consumer or auto demand is (will be) lo...	Consumer demand	1.0
62	Lack of purchasing power; people don't ...	Income/employment	0.9
63	Drop in employment (except 60); high or...	Income/employment	3.2
64	Population increase; immigration	Income/employment	0.1
65	High (higher) debts; lower assets/savin...	Credit/stocks	0.2
67	Other references to employment and purc...	None/other	0.1
68	Production decreasing; production is lo...	Production/quality	0.4
69	Real estate/housing market in decline; ...	Credit/stocks	0.3
70	Financial crisis; financial institution...	Credit/stocks	0.1
71	Prices are falling/will fall/are too lo...	Prices	0.1
72	Prices are high, are rising, inflation;...	Prices	2.3
73	Tight money; credit hard to get; intere...	Credit/stocks	1.0
74	Profits low, falling	Production/quality	0.1
75	Profits high; too high	Production/quality	0.0
76	Stock market references; decline in pri...	Credit/stocks	0.9
77	Other price/credit references	None/other	0.1
78	Balance of payments; foreign competitio...	Trade	0.8
79	Controls (price and/or wage)	Government	0.0
80	Bad race relations; racial unrest; riot...	None/other	0.1
81	Excessive wage or other demands by unio...	Labor relations	0.4
82	Times are (business is) bad now and won...	None/other	0.2
83	Good times can't last–we are due for a...	None/other	0.0
84	R sees signs of downward trend in busin...	None/other	1.0
85	Decline in specific industries; problem...	Production/quality	3.6
86	Farm situation is bad; drought; low far...	Production/quality	0.2
87	Other unfavorable or bad factors (inclu...	None/other	1.2
88	Economy in general less stable/not unde...	Consumer demand	0.2
89	Energy crisis; depletion of natural res...	Energy	0.3
90	Business/Accounting scandals	Credit/stocks	0.1
97	Change mentioned but NA whether favorab...	None/other	0.0

Table C9: MSC Reasoning Summary: PAGOR1

Code	Description	Category	Fraction
0	Inap, no change and no pro-con reason g...	None/other	7.8
10	Better pay: raise in wages or salary on...	Income/employment	14.6
11	Higher income from self-employment or p...	Income/employment	3.5
12	More work, hence more income: Head (or ...	Income/employment	13.4
13	Increased contributions from outside FU...	None/other	2.3
14	Lower prices: decrease in cost of livin...	Prices	0.6
15	Lower taxes; low or unchanged taxes	Taxes	0.2
16	Decreased expenses: fewer people to be ...	None/other	3.1
18	Higher interest rates	Credit/stocks	0.0
19	Better asset position: more savings; bu...	Credit/stocks	3.7
20	Debt, interest or debt payments low or ...	Credit/stocks	3.7
21	Change in family composition means high...	None/other	0.6
23	Good times, no recession (not codeable ...	None/other	0.5
27	Other reasons for making FU better off:...	None/other	3.8
38	Reference to government economic policy...	Government	0.1
39	Income tax refund	Taxes	0.0
50	Lower pay: decrease in wages or salary ...	Income/employment	3.1
51	Lower income from self-employment or pr...	Income/employment	2.4
52	Less work, hence less income: unemploye...	Income/employment	10.0
53	Decreased/Unchanged contributions from ...	None/other	1.8
54	High(er) prices: increase in cost of li...	Prices	14.3
55	Higher interest rates	Prices	0.1
56	High, higher taxes (except 57)	Taxes	0.6
57	Income taxes	Taxes	0.2
58	Increased expenses; more people to be s...	None/other	3.0
59	Worse asset position: savings used up w...	Credit/stocks	2.1
60	Debt: interest, debt, or debt payments ...	Credit/stocks	1.5
61	Change in family composition means lowe...	None/other	1.1
63	Bad times, recession (not codeable abov...	None/other	0.7
64	Strike(s)–not codeable in 52	Labor relations	0.0
67	Other reasons for making FU worse off: ...	None/other	0.9
78	Reference to government economic policy...	Government	0.2

Table C10: MSC Reasoning Summary: PAGOR2

Code	Description	Category	Fraction
0	Inap, no change and no pro-con reason g...	None/other	65.7
10	Better pay: raise in wages or salary on...	Income/employment	1.9
11	Higher income from self-employment or p...	Income/employment	0.7
12	More work, hence more income: Head (or ...	Income/employment	1.6
13	Increased contributions from outside FU...	None/other	0.7
14	Lower prices: decrease in cost of livin...	Prices	0.7
15	Lower taxes; low or unchanged taxes	Taxes	0.2
16	Decreased expenses: fewer people to be ...	None/other	2.2
18	Higher interest rates	Credit/stocks	0.0
19	Better asset position: more savings; bu...	Credit/stocks	1.7
20	Debt, interest or debt payments low or ...	Credit/stocks	2.1
21	Change in family composition means high...	None/other	0.2
23	Good times, no recession (not codeable ...	None/other	0.6
27	Other reasons for making FU better off:...	None/other	2.9
38	Reference to government economic policy...	Government	0.1
39	Income tax refund	Taxes	0.0
50	Lower pay: decrease in wages or salary ...	Income/employment	2.5
51	Lower income from self-employment or pr...	Income/employment	0.6
52	Less work, hence less income: unemploye...	Income/employment	1.3
53	Decreased/Unchanged contributions from ...	None/other	1.8
54	High(er) prices: increase in cost of li...	Prices	5.7
55	Higher interest rates	Prices	0.2
56	High, higher taxes (except 57)	Taxes	0.7
57	Income taxes	Taxes	0.1
58	Increased expenses; more people to be s...	None/other	1.7
59	Worse asset position: savings used up w...	Credit/stocks	0.7
60	Debt: interest, debt, or debt payments ...	Credit/stocks	0.7
61	Change in family composition means lowe...	None/other	0.2
63	Bad times, recession (not codeable abov...	None/other	0.8
64	Strike(s)–not codeable in 52	Labor relations	0.0
67	Other reasons for making FU worse off: ...	None/other	1.2
78	Reference to government economic policy...	Government	0.4

Table C11: MSC Reasoning MCA Coordinates

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
0		-0.47		-0.34		-0.49	-1.00	-0.70	0.11	-0.19
10	-0.31	0.16	0.40	0.47	0.25	0.21	0.86	1.80	0.75	1.02
11	-0.05	1.23	0.21	1.49	-0.12	0.90	0.42	1.26	1.00	1.60
12	-0.08	0.89	-0.10	1.05	-0.56	0.41	0.55	1.58	-0.01	0.60
13	-0.48	0.75	-0.18	0.87	-0.26	0.62	-0.32	0.98	0.19	0.91
14	-0.35	0.34	-0.13	0.86	-0.08	0.79	1.24	1.86	1.05	1.52
15	-0.16	0.09	0.18	0.56	-0.54	-0.00	0.42	1.58	1.59	1.86
16	0.53	0.79	0.92	1.16	0.38	0.25	1.63	2.11	0.10	0.90
17	0.21	0.66	0.21	0.85	-0.07	0.54	-0.33	0.80		
18	0.36	0.61	0.44	0.77	0.35	0.56	1.15	2.48	0.34	0.69
19	1.39	1.33	1.16	1.36	-0.13	0.38	1.49	2.03	1.43	1.82
20	0.33	0.20					1.52	1.62	0.28	1.10
21	0.56	1.60	0.80	1.52	0.18	1.23	1.32	2.07	-0.32	0.26
22							1.30	2.75		
23	-0.53	0.40	-0.04	0.69	-0.58	0.22	1.36	2.17	1.05	1.95
24							0.28	1.39		
25	0.94	0.79					1.12	1.68		
27					-1.04	1.03	-0.04	0.71	-0.73	0.54
28							2.19	2.64		
29							0.59	1.21		
30	0.64	0.40					1.62	2.67		
31	2.42	2.22	2.80	2.78	-0.01	0.82	1.83	2.21		
32	0.61	0.89	0.77	0.73	-0.08	0.47	1.01	1.61		
33	0.54	1.29	0.69	1.13	0.50	1.06	1.21	1.86		
34	0.91	1.13	0.88	0.99	-0.08	0.37		3.78		
35	-0.47	-0.29					1.72	2.09		
36	1.53	0.84					1.32	1.85		
37	0.23	0.01					0.62	1.06		
38	0.73	0.62					0.99	1.73	1.47	2.28
39	0.16	0.85					-0.72	-0.82	1.47	0.92
40	0.60	0.74					-0.88	1.50		
41	-1.35	0.28	-1.39	-0.41	-1.85	0.09	1.44	2.47		
42	-1.26	0.13	-0.83	-0.81	-1.49	0.11	1.02	1.81		
43	0.31	2.24	1.37	2.51	-0.23	0.21	-0.47	0.51		
44	0.70	-1.24			-0.59	0.35	0.11	1.07		
45	0.82	-0.71			-0.17	0.32	-0.13	0.94		
46	0.01	0.68		-1.20	0.26	0.60	0.80	0.83		
47	-1.17	0.15	-0.91	0.05	-1.43	-0.03	-0.24	0.90	-1.24	
48					0.23	0.94	1.07	1.72		
49	0.50	1.12	0.94	1.48	0.09	0.59	1.16	2.01		

Notes: estimated coordinates from our reasoning MCA (second factor; see Figure 10). Each column corresponds to a separate reason question from the MSC: CARRN1, CARRN2, DURRN1, DURRN2, HOMRN1, HOMRN2, NEWS1, NEWS2, PAGOR1, PAGOR2 (respectively); each row corresponds to a numeric reasoning code (see Tables C1-C10). Coordinates continued in Table C12.

Table C12: MSC Reasoning MCA Coordinates (continued)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
50	0.27	-0.41	-0.84	-1.77	-0.86	-0.98	0.43	1.09	-0.23	0.04
51	-0.68	0.05	-0.34	0.81	-0.71	-0.56	0.80	1.33	-0.44	-0.11
52	3.55	6.12	3.68	7.86	3.36	2.90	0.06	0.10	-0.99	-0.83
53	-0.16	1.41	0.00	1.35	0.17	2.65	-0.31	-0.29	-1.16	-1.07
54	-1.11	-1.70	-0.51	-1.03	-1.27	-1.66	-0.55	0.18	-0.14	-0.24
55	-1.29	-1.22	-2.13	-1.27	-1.02	-0.81	2.40	1.66	0.18	0.92
56	0.21	0.57	0.08	0.01	0.09	1.04	1.07	0.91	-0.45	-0.28
57	-1.63	-1.63	-1.31	-1.70	-1.42	-1.25	-0.50	-0.45	-0.21	-0.01
58	0.41	0.48	0.70	0.66	0.33	0.51	0.56	1.03	-0.71	-0.49
59	0.73	0.53	1.10	0.34	-1.11	-0.65	0.23	0.71	0.11	0.49
60	1.22	0.83					-0.42	0.02	-0.89	-0.74
61	-2.33	-0.98	-1.81	-0.50	-2.22	-0.58	-0.21	0.18	-1.04	-1.18
62	-1.42	-0.69	-0.93	-0.34	-1.47	-0.56	-0.05	0.20	-2.14	
63	-0.79	-1.08	-0.66	-0.53	-1.22	0.20	-0.12	0.32	-1.02	-0.96
64		-2.32					0.26	0.69	-1.27	0.04
65	-0.89	-0.68	-0.86	-0.72	-1.60	-0.98	-0.36	-0.19		
67	0.10	-0.33					-0.55	-0.49	-1.22	-0.95
68							5.58	5.28		
69	0.38	-0.44					-0.17	-0.24		
70	-0.37	-0.39				2.43	0.65	0.09		
71	7.04	6.33	7.55	7.26	2.57	3.60	0.68	1.10		
72	-0.68	-0.54	0.08	0.58	-1.14	-0.51	1.40	2.02		
73	0.46	0.88	0.01	1.31	0.05	-1.05	1.07	1.70		
74	2.21	1.99					0.60	0.62		
75	-0.78	-1.36					1.10	1.26		
76	-0.19	-0.21					0.22	0.82		
77	-0.90	0.25					-0.10	0.33		
78	-0.21	0.01					0.64	0.88	-0.14	0.36
79	0.10	0.83					-0.37	-0.59		
80	1.79	0.00					0.42	0.62		
81	-1.37	0.93	-1.15	-0.18	-1.97	-0.42	2.08	2.64		
82	-0.08	0.58	1.53	2.95	-1.17	-1.13	-0.73	-0.54		
83	0.39	0.07			-0.09	-0.40	1.48	0.70		
84	0.17	-0.01			-0.31	0.05	-0.54	-0.26		
85	-0.06	-1.19			-0.66	-0.91	-0.58	0.00		
86	-1.50	-0.27			-0.63	0.61	-0.18	0.57		
87	-1.27	-0.94	-1.29	-0.61	-1.63	-0.82	-0.55	0.20		
88	-1.44	-0.75			-0.44	-0.29	-0.46	-0.04		
89	-0.66	-0.67	-0.97	-1.08	-1.31	-1.40	0.11	1.02		
90	-0.40	0.03					-0.11	-0.02		
91	2.74	2.27								
92	0.04	0.02								
93	-0.28	-0.86								
94	-0.90	-0.96								
95	0.06	-0.30								
96	0.58	-0.08								
97							-0.51	0.92		

Appendix D Model Appendix

D.1 Steady State and Log-Linearization Details

In this appendix, we provide additional details on the steady state and log-linearization of the model.

The central bank chooses the long-run policy rate $i^* \equiv -\log\beta$ which implies that steady-state inflation $\bar{\Pi} = 1 \iff \bar{\pi} = 0$. This implies that long-run real rates $\bar{r} = -\log\beta$, and hence steady-state holdings of (real) bonds $\bar{B} = 0$. The optimal production subsidy implies that in steady-state, real wages satisfy

$$\bar{W} = (1+\tau^{\mathcal{K}})\left(\frac{\epsilon-1}{\epsilon}\right) \equiv 1$$

Additionally, in steady state every firm chooses the same price, thus there is no price dispersion, and so

$$\bar{Y} = \bar{C} = \bar{N}$$

This implies that steady state profits are zero, as are transfers:

$$\bar{D} = (1-\tau^{\mathcal{K}})\bar{Y} - \bar{W}\bar{N} - \tau^{\mathcal{K}}\bar{Y} = 0$$

Since steady-state bond holdings are also zero, household transfers $\bar{T}^{\mathcal{H}} = \bar{T}^{F} = 0$. Combining the intratemporal optimality conditions with the budget constraints at steady state (and normalizing the steady-state labor disutility shock $\bar{\Gamma} = 1$) gives

$$\begin{gathered}\bar{C}^{\mathcal{K}} = \bar{W}\bar{N}^{\mathcal{K}}, \;\; \bar{C}^{\mathcal{H}} = \bar{W}\bar{N}^{\mathcal{H}} \\ \bar{W} = \bar{\Gamma}(\bar{C}^{\mathcal{K}})^{\sigma}(\bar{N}^{\mathcal{K}})^{\phi}, \;\; \bar{W} = \bar{\Gamma}(\bar{C}^{\mathcal{H}})^{\sigma}(\bar{N}^{\mathcal{H}})^{\phi} \\ \implies \bar{C} = \bar{C}^{\mathcal{K}} = \bar{C}^{\mathcal{H}}, \;\; \bar{N} = \bar{N}^{\mathcal{K}} = \bar{N}^{\mathcal{H}}\end{gathered}$$

Then since $\bar{C}^{\mathcal{H}} = \bar{C}^{\mathcal{K}}$ and $\bar{N}^{\mathcal{H}} = \bar{N}^{\mathcal{K}}$, we have

$$y_t = c_t = \lambda c_t^{\mathcal{H}} + (1-\lambda)c_t^{\mathcal{K}} \tag{D1}$$

$$y_t = n_t = \lambda n_t^{\mathcal{H}} + (1-\lambda)n_t^{\mathcal{K}} \tag{D2}$$

since price dispersion is zero to a first order (see Galí 2015). Profits are given by

$$d_t = -w_t$$

Thus we have that the $\mathcal{K}$ optimality conditions are given by equations (9). The log-linearized firm optimality conditions for optimal update price P_t^* imply (see Galí 2015):

$$\pi_t = \frac{(1-\beta\theta)(1-\theta)}{\theta} w_t + \beta \mathbb{E}_t \pi_{t+1}$$

Finally, the linearized $\mathcal{H}$ budget constraint is given by $c_t^{\mathcal{H}} = n_t^{\mathcal{H}} + \left(1 - \tau^D/\lambda\right) w_t$, which combined with the intratemporal optimality conditions gives equations (11).

D.2 Kalman Prior and Posterior Invertibility

In this appendix, we show that whenever $\mu > 0$, the time-invariant prior and posterior covariance matrices are invertible.

Note that have

$$\begin{aligned}
\mathbf{\Sigma}_{1|1} &= (\mathbf{I} - \mathbf{KH})\, \mathbf{\Sigma}_{1|0} \\
&= \mathbf{\Sigma}_{1|0} - \mathbf{\Sigma}_{1|0}^{1/2} \mathbf{U}_1 \left(\mathbf{I}_1 + \mathbf{\Sigma}_\eta\right)^{-1} \mathbf{U}_1^\top \mathbf{\Sigma}_{1|0}^{1/2} \\
&= \mathbf{\Sigma}_{1|0}^{1/2} \mathbf{U} \begin{bmatrix} \frac{\mu}{2} \cdot \mathbf{\Lambda}_1^{-1} & \mathbf{0} \\ \mathbf{0} & \mathbf{I}_2 \end{bmatrix} \mathbf{U}^\top \mathbf{\Sigma}_{1|0}^{1/2}
\end{aligned}$$

where the final line follows from

$$1 + \sigma_{\eta,i} = 1 + \frac{1}{2\Lambda_i/\mu - 1} \implies \left(\mathbf{I}_1 + \mathbf{\Sigma}_\eta\right)^{-1} = \mathbf{I}_1 - \frac{\mu}{2} \cdot \mathbf{\Lambda}_1^{-1}$$

Note that whenever $\mu > 0$, the block diagonal matrix above is invertible. Thus, if $\mathbf{\Sigma}_{1|0}$ is invertible, so is $\mathbf{\Sigma}_{1|1}$.

Additionally, we have

$$\mathbf{\Sigma}_{1|0} = \mathbf{A}\mathbf{\Sigma}_{1|1}\mathbf{A}^\top + \mathbf{C}\mathbf{C}^\top = \begin{bmatrix} \begin{bmatrix} \mathbf{A}_x & \mathbf{C}_x \end{bmatrix} \mathbf{\Sigma}_{1|1} \begin{bmatrix} \mathbf{A}_x^\top \\ \mathbf{C}_x^\top \end{bmatrix} & \mathbf{0} \\ \mathbf{0} & \mathbf{I} \end{bmatrix}$$

Then if $\mathbf{\Sigma}_{1|1}$ is invertible and assuming $\begin{bmatrix} \mathbf{A}_x & \mathbf{C}_x \end{bmatrix}$ is full row rank, the upper-left block above is positive definite (since $\mathbf{\Sigma}_{1|1}$ is positive definite). Thus $\mathbf{\Sigma}_{1|0}$ is invertible.

As $\mu \to 0$, if $\mathbf{\Omega}$ is full rank, then for μ small enough, all eigenvalues will satisfy the conditions in Proposition 1 and so the block diagonal matrix simply becomes $\frac{\mu}{2} \cdot \mathbf{\Lambda}^{-1}$, so as $\mu \to 0$ $\mathbf{\Sigma}_{1|1} \to \mathbf{0}$. However, when $\mathbf{\Omega}$ is not full rank, there are are set of zero eigenvalues, thus as $\mu \to 0$, we have

$$\begin{bmatrix} \frac{\mu}{2} \cdot \mathbf{\Lambda}_1^{-1} & \mathbf{0} \\ \mathbf{0} & \mathbf{I}_2 \end{bmatrix} \to \begin{bmatrix} \mathbf{0} & \mathbf{0} \\ \mathbf{0} & \mathbf{I}_2 \end{bmatrix}$$

Thus, $\mathbf{\Sigma}_{1|1}$ converges to a non-zero (singular) matrix.

D.3 Hand-to-Mouth Quadratic Utility

In this appendix, we formally derive the log-quadratic approximation of hand-to-mouth household utility.

The information-constrained households choose labor N_t^j, and consumption C_t^j is determined as a residual. Write the concentrated utility function as

$$\mathcal{U}(N_t^j; W_t, D_t, \Gamma_t) \equiv \frac{\left(W_t N_t^j + (\tau^D/\lambda) D_t\right)^{1-\varsigma} - 1}{1-\varsigma} - \Gamma_t \frac{\left(N_t^j\right)^{1+\varphi}}{1+\varphi}$$

Re-write all variables in terms of log deviations from the steady state (for any variable $X_t \equiv \bar{X} e^{x_t}$, except aggregate profits, where we instead have $D_t = \bar{Y} d_t$). Then taking derivatives with respect to the choice variables $n_t^{\mathcal{H},j}$ evaluated at the steady state gives

$$\left.\frac{\partial \mathcal{U}}{\partial n_t^{\mathcal{H},j}}\right|_{SS} = 0, \quad \left.\frac{\partial^2 \mathcal{U}}{\partial (n_t^{\mathcal{H},j})^2}\right|_{SS} = -(\varsigma + \varphi)$$
$$\left.\frac{\partial^2 \mathcal{U}}{\partial n_t^{\mathcal{H},j} \partial w_t}\right|_{SS} = 1 - \varsigma, \quad \left.\frac{\partial^2 \mathcal{U}}{\partial n_t^{\mathcal{H},j} \partial \gamma_t}\right|_{SS} = -1, \quad \left.\frac{\partial^2 \mathcal{U}}{\partial n_t^{\mathcal{H},j} \partial d_t}\right|_{SS} = -\varsigma$$

Next, from our log-linearization we have that $d_t = -w_t$. Finally, define the (endogenous) vectors $\mathbf{A}_w$ and $\mathbf{A}_\gamma$ so that $\mathbf{A}_w^\top \mathbf{X}_t = w_t$ and $\mathbf{A}_\gamma^\top \mathbf{X}_t = \gamma_t$ in equilibrium. Then we have that the quadratic approximation for $\mathcal{H}$ household utility is given by (18), where

$$\mathbf{B}_{aa} = \frac{1}{2}(\varsigma + \varphi) \tag{D3}$$

$$\mathbf{B}_{xa} = \begin{bmatrix} \mathbf{A}_w & \mathbf{A}_\gamma \end{bmatrix} \begin{bmatrix} \chi_n \\ -1 \end{bmatrix} \tag{D4}$$

Note that $\mathbf{B}_{aa}$ is a scalar, and hence the loss matrix $\mathbf{\Omega}$ from (21) is rank one and the eigenvector associated with the only nonzero eigenvalue is (proportional to) (D4):

$$\mathbf{\Omega} = \mathbf{v}\mathbf{v}^\top, \quad \mathbf{v} \equiv \left(\frac{1}{4}\frac{1}{\sqrt{\varsigma+\varphi}}\right)\cdot \mathbf{\Sigma}_{1|0}^{1/2}\mathbf{B}_{xa}$$
$$\implies \Lambda_1 = \mathbf{v}\mathbf{v}^\top, \quad \mathbf{u}_1 = \Lambda_1^{-1}\cdot \mathbf{v}$$

Then we have that the signal coefficient matrix is a row vector

$$\begin{aligned}\mathbf{H} &= \Lambda_1^{-1}\cdot \mathbf{v}\mathbf{\Sigma}_{1|0}^{-1/2} \\ &= \Lambda_1^{-1}\left(\frac{1}{4}\frac{1}{\sqrt{\varsigma+\varphi}}\right)\cdot \mathbf{B}_{xa}\end{aligned}$$

and the signal noise covariance is a scalar:

$$\mathbf{\Sigma}_\eta \equiv \sigma_\eta^2 = \left(2\Lambda_1/\mu - 1\right)^{-1}$$

assuming that $\Lambda_1 > \frac{1}{2}\mu$. Define the following transformed (scalar) Kalman gain

$$K \equiv \mathbf{H}\mathbf{K} = \frac{1}{1+\sigma_\eta^2}$$

which follows from the general result above regarding $\mathbf{HK}$.

Note from the definition of $\mathbf{B}_{xa}$ in this case, we find

$$\begin{aligned}\mathbf{B}_{xa}^\top \mathbf{X}_t = \begin{bmatrix}\chi_n & -1\end{bmatrix}\begin{bmatrix}w_t \\ \gamma_t\end{bmatrix} &= \chi_n w_t - \gamma_t \equiv (\varsigma+\varphi) n_t^{\mathcal{H},*} \\ \implies \mathbf{H}\mathbf{X}_t &= \Lambda_1^{-1}\left(\frac{1}{4}\frac{1}{\sqrt{\varsigma+\varphi}}\right)\cdot(\varsigma+\varphi) n_t^{\mathcal{H},*} \\ \mathbf{H}\hat{\mathbf{X}}_t^j &= \Lambda_1^{-1}\left(\frac{1}{4}\frac{1}{\sqrt{\varsigma+\varphi}}\right)\cdot(\varsigma+\varphi) \hat{n}_t^{\mathcal{H},*,j} \\ \mathbf{H}\tilde{\mathbf{X}}_t^j &= \Lambda_1^{-1}\left(\frac{1}{4}\frac{1}{\sqrt{\varsigma+\varphi}}\right)\cdot(\varsigma+\varphi) \tilde{n}_t^{\mathcal{H},*,j}\end{aligned}$$

Then we have

$$\hat{\mathbf{X}}_t^j = \left(\mathbf{I} - \mathbf{K}\mathbf{H}\right)\tilde{\mathbf{X}}_t^j + \mathbf{K}s_t^j$$
$$\implies \hat{n}_t^{\mathcal{H},*,j} = K\left(n_t^{\mathcal{H},*} + \eta_t^j\right) + (1-K)\tilde{n}_t^{\mathcal{H},*,j}$$

D.4 Equilibrium Response Coefficients (No Dynamics)

The coefficients in equations (25) are given by

$$C_{y,v} \equiv \frac{1-\lambda}{(1-\lambda)\tilde{\omega}_y \kappa_w \phi_\pi + \varsigma(1-\lambda\tilde{\zeta}_y)} \tag{D5}$$

$$C_{y,\gamma} \equiv \frac{\varsigma\lambda\tilde{\zeta}_\gamma - (1-\lambda)\tilde{\omega}_\gamma \kappa_w \phi_\pi}{(1-\lambda)\tilde{\omega}_y \kappa_w \phi_\pi + \varsigma(1-\lambda\tilde{\zeta}_y)} \tag{D6}$$

$$C_{\pi,v} \equiv \frac{(1-\lambda)\kappa_w \tilde{\omega}_y}{(1-\lambda)\tilde{\omega}_y \kappa_w \phi_\pi + \varsigma(1-\lambda\tilde{\zeta}_y)} \tag{D7}$$

$$C_{\pi,\gamma} \equiv \frac{\varsigma\kappa_w \left(\tilde{\omega}_\gamma(1-\lambda\tilde{\zeta}_y) + \lambda\tilde{\omega}_y\tilde{\zeta}_\gamma\right)}{(1-\lambda)\tilde{\omega}_y \kappa_w \phi_\pi + \varsigma(1-\lambda\tilde{\zeta}_y)} \tag{D8}$$

where

$$\tilde{\omega}_\gamma \equiv \frac{1-\lambda(1-K)}{1-\chi_n\lambda(1-K)} \tag{D9}$$

$$\tilde{\omega}_y \equiv \frac{\varsigma+\varphi}{1-\chi_n\lambda(1-K)} \tag{D10}$$

$$\tilde{\zeta}_\gamma \equiv \frac{\varsigma^{-1}(1-\chi_n)(\varphi(1-\lambda(1-K)) + \varsigma(1-K)(1-\lambda))}{(\varsigma+\varphi)(1-\chi_n\lambda(1-K))} \tag{D11}$$

$$\tilde{\zeta}_y \equiv \frac{\varsigma^{-1}(1-\chi_n)\varphi + 1 - \chi_n(1-K)}{1-\chi_n\lambda(1-K)} \tag{D12}$$

D.4.1 Expectations Manipulation (No Dynamics)

Following the same steps as in Section 3, we find

$$\begin{aligned}
w_t &= \tilde{\omega}_\gamma \gamma_t + \tilde{\omega}_y y_t + \tilde{\omega}_z z_t \\
c_t^{\mathcal{H}} &= \tilde{\zeta}_\gamma \gamma_t + \tilde{\zeta}_y y_t + \tilde{\zeta}_z z_t \\
\implies y_t &= (1-\lambda\tilde{\zeta}_y)^{-1}\left[(1-\lambda)\varsigma^{-1}(v_t - \phi_\pi\pi_t) + \lambda\tilde{\zeta}_\gamma\gamma_t + \lambda\tilde{\zeta}_z z_t\right] \\
\pi_t &= \kappa_w\tilde{\omega}_\gamma\gamma_t + \kappa_w\tilde{\omega}_y y_t
\end{aligned}$$

where we additionally have the terms related to the expectation shock:

$$\tilde{\omega}_z = -K \frac{\lambda(\varsigma + \varphi)}{1 - \lambda\chi_n(1-K)}$$
$$\tilde{\zeta}_z = -K \frac{\varsigma^{-1}(1-\chi_n)\lambda\varphi - (1-\lambda)}{1 - \lambda\chi_n(1-K)}$$

Appendix E Alternative Household Decision-Making Structure

In this Appendix, we study the implications of our model if we change the decision-making structure within the inattentive hand-to-mouth households. Under full-information, whether the hand-to-mouth agents "actively" choose labor supply and "passively" choose consumption (such that the budget constraint binds) or vice versa is irrelevant. But under rational inattention, in principle these choices are not innocuous because it changes how the household chooses to collect information. We therefore study the case where the head-of-household actively chooses consumption (and so labor supply must endogenously adjust so the budget constraint binds) and derive conditions under which posterior beliefs of output and inflation are negatively correlated. We then extend the problem so that the household chooses *ex ante* which decision is made "actively" and which is made "passively."

The $\mathcal{H}$ household payoff function (6) is now written in concentrated form as

$$E_t^j \, U\left(C_t^{\mathcal{H},j}; \mathbf{X}_t\right) - \mu I\left(\mathbf{X}_t; \mathcal{I}_t^j \,\middle|\, \mathcal{I}_{t-1}^j\right), \quad N_t^{\mathcal{H},j} = \frac{C_t^{\mathcal{H},j} - T_t^{\mathcal{H}}}{W_t}.$$

Following similar steps as in Section 3, we first solve (log-linearized) endogenous objects as a function of aggregate $\mathcal{H}$ consumption $c_t^{\mathcal{H}} \equiv (1/\lambda)\int_0^\lambda c_t^{\mathcal{H},j}\,\mathrm{d}j$. Combining the $\mathcal{K}$ household optimality conditions with the $\mathcal{H}$ household budget constraint, the wage and output dynamics are given by

$$w_t = \frac{(1-\lambda)\gamma_t + (\varsigma+\varphi)(y_t - \lambda c_t^{\mathcal{H}})}{1-\lambda\chi_c} \equiv \omega_\gamma \gamma_t + \omega_y y_t + \omega_c c_t^{\mathcal{H}},$$
$$\mathbb{E}_t \Delta y_{t+1} = (1-\lambda)\varsigma^{-1}\left(i_t - \mathbb{E}_t\pi_{t+1} - v_t\right) + \lambda \mathbb{E}_t \Delta c_{t+1}^{\mathcal{H}},$$

and the Phillips curve is given by

$$\pi_t = \kappa_w \left[\omega_\gamma \gamma_t + \omega_y y_t + \omega_c c_t^{\mathcal{H}}\right] + \beta \mathbb{E}_t \pi_{t+1}.$$

Of course, the optimal decisions under full-information (11) are unchanged. Corollary 1.1 implies that the average consumption decision of $\mathcal{H}$ households is simply $c_t^{\mathcal{H}} = K c_t^{\mathcal{H},*}$. Thus we have

$$\begin{aligned} w_t &= \frac{(\omega_\gamma - \hat{\omega}_c)\gamma_t + \omega_y y_t}{1 - \hat{\omega}_c \chi_c} \equiv \tilde{\omega}_\gamma \gamma_t + \tilde{\omega}_y y_t, \\ c_t^{\mathcal{H}} &= \frac{K\left((\chi_c \tilde{\omega}_\gamma - 1)\gamma_t + \chi_c \tilde{\omega}_y y_t\right)}{\varsigma + \varphi} \equiv \tilde{\zeta}_\gamma \gamma_t + \tilde{\zeta}_y y_t, \end{aligned}$$

where $\hat{\omega}_c \equiv \frac{K\omega_c}{\varsigma+\varphi}$. Then under the assumption of iid dynamics (so FIRE expectations $\mathbb{E}_t x_{t+1} = 0$ for any variables x_{t+1}), we have that the aggregate dynamics of output and inflation are the same as in (25), and the expressions for the coefficients $C_{y,v}, C_{y,\gamma}, C_{\pi,v}, C_{\pi,\gamma}$ are given by equations (D5)-(D8), but as a function of the terms $\tilde{\omega}_y, \tilde{\omega}_\gamma, \tilde{\zeta}_y, \tilde{\zeta}_\gamma$ defined in this Appendix.

Proposition 6 (Hand-to-Mouth Posterior Beliefs, Alternative Decision Structure)**.** *The unconditional correlation of output and inflation is positive iff*

$$C_{y,v} C_{\pi,v} \sigma_v^2 + C_{y,\gamma} C_{\pi,\gamma} \sigma_\gamma^2 > 0. \tag{E1}$$

When $\chi_c \neq 0$, posterior beliefs of output and inflation are negatively correlated iff

$$\left(C_{y,v}\sigma_v^2 + \Xi C_{y,\gamma}\sigma_\gamma^2\right) \cdot \left(C_{\pi,v}\sigma_v^2 + \Xi C_{\pi,\gamma}\sigma_\gamma^2\right) < 0, \tag{E2}$$

where $\Xi \equiv \frac{\chi_c(\tilde{\omega}_y C_{y,\gamma} + \tilde{\omega}_\gamma) - 1}{\chi_c \tilde{\omega}_y C_{y,v}}$. If $\chi_c = 0$, then (E2) is equivalent to $C_{y,\gamma} C_{\pi,\gamma} < 0$.

If Assumption 1 holds:

(i) If $\chi_c = 0$, then (E2) is satisfied $\forall \sigma_\gamma > 0$.

(ii) If $\chi_c \neq 0$, then $\exists\ \overline{\sigma_\gamma}$ such that $\sigma_\gamma < \overline{\sigma_\gamma}$ implies that (E2) does not hold.

The proof is nearly identical to the proof of Prop. 3 and Corollary 3.1. However, despite the similarity, the conditions under which $\chi_c \approx 0$ are less natural than when $\chi_n \approx 0$. Recall that

$$\chi_c = 1 + \varphi(1 - \tau^D/\lambda), \quad \chi_n = 1 - \varsigma(1 - \tau^D/\lambda),$$

so the natural benchmark of log utility ($\varsigma \to 1$) and no transfers ($\tau^D/\lambda \to 0$) implies that $\chi_n \to 0$ but $\chi_c \to 1+\varphi > 1$. In this case, and unlike the benchmark case considered in the main text, negative correlation of posterior beliefs regarding output and inflation will not necessarily hold under any value of γ shock volatility σ_γ. Instead, when σ_γ is arbitrarily small, negative posterior belief correlation is recovered when fiscal transfers are "progressive" in the sense that $\tau^D/\lambda > 1$ (that is, the fiscal authority conducts transfers which more than offset the profits earned by firm owners). Of course, for intermediate values of σ_γ, negative posterior belief correlation may still arise even when $\chi_c > 1$.

Finally, we consider the question of which decision-making structure is optimal *a priori* from the perspective of the head-of-household. In other words, we now relax the problem further and study when hand-to-mouth households would *ex ante* choose the decision-making structure where labor supply is actively chosen (the baseline model), or where consumption is actively chosen (the alternative considered above). Given the assumption that hand-to-mouth households are myopic, one can show that the log-quadratic approximations of lifetime utility given the two decision-making structures implies

$$\mathcal{U}^N - \mathcal{U}^* \approx -\frac{\varsigma+\varphi}{2}\left(n_t^{\mathcal{H},j} - n_t^{\mathcal{H},*}\right)^2,$$
$$\mathcal{U}^C - \mathcal{U}^* \approx -\frac{\varsigma+\varphi}{2}\left(c_t^{\mathcal{H},j} - c_t^{\mathcal{H},*}\right)^2,$$

where $\mathcal{U}^N$,$\mathcal{U}^C$ are lifetime utility when making active labor supply or consumption decisions (respectively); and $\mathcal{U}^*$ is lifetime utility under full-information. Intuitively, because the decision-making structure is irrelevant under full-information, when deciding between the two structures, the household wishes to know which decision-making structure gets "closer" (in a utility sense) to the outcomes under full-information. This in turn depends on two factors: how much information is required to mimic the full-information strategy, and how costly sub-optimal decisions are (in terms of utility). For the hand-to-mouth households considered in our model, these factors are summarized by the preference parameters ($\varsigma+\varphi$) and the volatility between the actual choices taken under imperfect information relative to the full-information choices.[28]

Thus, the household will prefer $\mathcal{U}^N$ to $\mathcal{U}^C$ iff the volatility of optimal labor supply is

[28]Under more general information-acquisition problems, the decision of which set of choices to "residualize" and which to choose "actively" is an interesting and more complicated problem. We do not explore this issue here further and leave this to future work.

less than the volatility of optimal consumption. Abstracting from the specific dynamics of the model, we see that this condition is satisfied iff

$$(\chi_c^2 - \chi_n^2)\mathbb{V}ar[w_t] - (\chi_c - \chi_n)\mathbb{C}ov[w_t, \gamma_t] > 0.$$

If we consider the case where γ_t shock volatility σ_γ^2 is small, then this condition is approximately equivalent to $\chi_c^2 > \chi_n^2$. In other words, if the optimal (full-information) consumption decision reacts more strongly to the wage than labor supply, the household prefers to actively choose labor supply; if the opposite is true, then the household prefers to actively choose consumption. Standard parameter choices usually imply $|\chi_n| < |\chi_c|$; for instance, the natural benchmark case of log utility and no transfers implies $\chi_n = 0$ and $\chi_c = 1 + \varphi > 1$; in this case, the household prefers choosing labor supply. On the other hand, if the fiscal authority sets $\tau^D/\lambda = 1$, then $\chi_c = \chi_n = 1$ and the household is indifferent between either decision structure. If the fiscal authority is more aggressive so that $\tau^D/\lambda > 1$, then $\chi_c < 1$ and $\chi_n > 1$, so generally in this case the household would prefer to actively choose consumption. However, note that this condition is the one considered above under which posterior beliefs regarding output and inflation are typically negatively correlated.

Thus, while the quantitative predictions of the model differ when considering alternative decision-making structures, our qualitative finding that hand-to-mouth households still overweight aggregate factors which move output and inflation in opposite directions is robust. Further, the decision-making process we consider in the main text is the optimal one under many parameterizations of the model.

Appendix F Model Extensions

In this Appendix, we extend the baseline model presented in the paper along three dimensions. First, we introduce aggregate technology shocks into the production function. Second, we relax the assumption that the rationally inattentive households are hand-to-mouth, and instead allow them to access financial markets. Third, we allow for rationally inattentive firms.

Our goal is to explore the robustness of our theoretical result in the baseline model that rationally inattentive agents overweight aggregate factors which move the output gap and inflation in opposite directions. Thus, as in Section 4 we focus on the case where the fraction of rationally inattentive agents is small, and aggregate shocks are iid.

Setup: The model setup is the same as Section 3, except for the following changes. First, we assume that the intermediate goods production function is given by

$$Y_t(i) = A_t N_t(i), \tag{F1}$$

where $A_t \equiv \bar{A}e^{a_t}$ is an aggregate technology shock. Second, we assume that the rationally inattentive households $j \in [0, \lambda]$ are able to borrow or save: their budget constraint is given by (4), but these households are subject to entropy-based information costs. Third, we assume that intermediate firms $i \in [0, \lambda]$ are also subject to these information frictions. To simplify the aggregate dynamics, we study the beliefs of these rationally inattentive agents in the limiting case as $\lambda \to 0$. We further assume that the exogenous drivers of aggregate dynamics are iid. In terms of log-deviations from steady state, we assume these innovations (discount factor shocks ψ_t, labor disutility shocks γ_t, and technology shocks a_t, represented by the vector $\mathbf{z}_t$) are mean-zero Gaussian processes with volatilities $\sigma_\psi, \sigma_\gamma, \sigma_a$, respectively.

Aggregate Dynamics: Since we take the limit as the fraction of rationally inattentive agents $\lambda \to 0$, the aggregate dynamics are the same as a canonical representative agent New Keynesian model. The log-linearized dynamics are given by

$$\begin{aligned}
\mathbb{E}_t \Delta x_{t+1} &= \varsigma^{-1} \left(i_t - \mathbb{E}_t \pi_t - v_t - r_t^n \right), \\
\pi_t &= \kappa_w \left(w_t - a_t \right) + \beta \mathbb{E}_t \pi_t, \\
i_t &= \phi_\pi \pi_t, \\
w_t &= \gamma_t + (\varsigma + \varphi) x_t + a_t,
\end{aligned}$$

where the output gap is defined $x_t = y_t - y_t^n$, the difference between actual and "natural" output $y_t^n = \frac{1+\varphi}{\varsigma+\varphi} a_t$. The natural rate and discount factor shocks are defined $r_t^n = \varsigma \mathbb{E}_t \Delta y_{t+1}^n$ and $v_t = -\mathbb{E}_t \Delta \psi_{t+1}$, respectively. Under the assumption of iid shocks, rational expectations implies that $\mathbb{E}_t z_{t+1} = 0$ for any variable z_{t+1} (defined in terms of deviations from steady state).

F.1 Inattentive Capitalist Problem

We suppose that rationally inattentive households choose labor N_t^j and savings B_t^j, so that consumption C_t^j is a residual determined by the budget constraint (see Section 3 and Appendix E for discussions of the structure of the household which gives rise to this decision-making process). Written recursively in terms of log-deviations from steady state, the inattentive capitalist problem is given by

$$v(b_{t-1}; \mathbf{z}_t) = \max_{n_t, b_t} E_t^j \left[u(c_t, n_t; \mathbf{z}_t) + \beta v\left(b_t; \mathbf{z}_{t+1}\right) \right] - \mu I\left(\mathbf{z}_t; \mathcal{I}_t^j \middle| \mathcal{I}_{t-1}^j\right),$$

and consumption satisfies $e^{c_t} = b_{t-1} + e^{w_t + n_t} + d_t - \beta e^{q_t + b_t}$. The households take as given the aggregate dynamics defined above, so if initial wealth $b_{t-1} = 0$, a log-quadratic approximation around the deterministic steady state implies

$$E_t^j \left[u(c_t, n_t; \mathbf{z}_t) + \beta v\left(b_t; \mathbf{z}_{t+1}\right) \right] \approx -\mathbf{a}_t^\top \mathbf{B}_{aa} \mathbf{a}_t + \mathbf{a}_t^\top \mathbf{B}_{az} \mathbf{z}_t,$$

where $\mathbf{a}_t^\top \equiv \begin{bmatrix} n_t & b_t \end{bmatrix}$ and

$$\mathbf{B}_{aa} \equiv \frac{1}{2} \begin{bmatrix} \varsigma + \varphi & -\beta\varsigma \\ -\beta\varsigma & -\frac{\beta(\varphi + \varsigma(1-\beta\varsigma))}{\varsigma + \varphi} \end{bmatrix},$$

$$\mathbf{B}_{az} \equiv \frac{1}{\varsigma + \kappa_w \phi_\pi (\varsigma + \varphi)} \begin{bmatrix} \varsigma + \varphi & -\kappa_w \phi_\pi (\varsigma + \varphi) & -(\varsigma + \varphi)(\kappa_w \phi_\pi (\varsigma - 1) + \varsigma) \\ \beta\varsigma & \beta\varsigma\kappa_w\phi_\pi & \beta\varsigma(\kappa_w\phi_\pi(\varsigma - 1) + \varsigma) \end{bmatrix}.$$

Note that the first-order terms drop out from the first-order conditions, and we have discarded terms independent of the choices of the household. Further, from the decision-making structure of the household described above, the current level (as well as history) of household asset positions $\{B_{t-k}^j\}_{k=0}^{\infty}$ are contained in the information set $\mathcal{I}_t^j$. Then since aggregate shocks are iid, the linear-quadratic approximation implies that for any function $f(b_t; \mathbf{z}_{t+1})$, we have $E_t^j \left[f(b_t; \mathbf{z}_{t+1}) \right] \approx \hat{f}(b_t; \mathbf{0}) \equiv \bar{f} + \bar{f}_b b_t + \frac{1}{2} \bar{f}_{bb} b_t^2$, where $\hat{f}(\cdot; \cdot)$ is the quadratic approximation of f (and once again, where terms independent of choice have been dropped).

Then the household rational inattention problem is a simple case of Prop. 1, where the state variables ψ_t, γ_t, a_t are iid. Moreover, the loss matrix $\mathbf{\Omega}$ in this case has one non-zero eigenvalue, whose eigenvector is proportional to

$$\mathbf{v} = \begin{bmatrix} -1 \\ \kappa_w \phi_\pi \\ \kappa_w \phi_\pi (\varsigma - 1) + \varsigma \end{bmatrix}.$$

Intuitively, when the inattentive capitalist begins the period with no initial wealth, the optimal choice under full information is to neither save nor borrow. Thus, an inattentive agent finds it optimal to collect more precise information on the optimal choice of labor only; any additional information would not help the household improve its economic decisions.

F.2 Inattentive Capitalist Beliefs

Since inattentive capitalists only observe a single-dimensional signal, the posterior survey beliefs across rationally inattentive households (see Section 3.1 and Prop. 2 for our model-consistent definitions of survey beliefs) will have at most one dimension. Further, the correlation of posterior survey beliefs regarding the output gap and inflation will satisfy

$$\text{sign}\,\mathbb{C}ov\left(\hat{x}_t^j, \hat{\pi}_t^j\right) = \text{sign}\,\mathbb{C}ov\left(x_t, n_t^*\right)\mathbb{C}ov\left(\pi_t, n_t^*\right).$$

This result follows from the proof of Corollary 2.1. Unlike the case of inattentive hand-to-mouth consumers considered in the baseline model, the conditions under which simultaneously $\mathbb{C}ov\left(x_t, \pi_t\right) > 0$ but $\mathbb{C}ov\left(\hat{x}_t^j, \hat{\pi}_t^j\right) < 0$ are more more complicated. Solving for the rational expectations equilibriums using the aggregate dynamics given above, we have

$$\begin{aligned}
\mathbb{C}ov\left(x_t, n_t^*\right) &\propto \sigma_\psi^2 + (\kappa_w\phi_\pi)^2\sigma_\gamma^2 + \frac{1+\varphi}{\varsigma+\varphi}\varsigma(\kappa_w\phi_\pi(\varsigma-1)+\varsigma)\sigma_a^2, \\
\mathbb{C}ov\left(\pi_t, n_t^*\right) &\propto \kappa_w(\varsigma+\varphi)\sigma_\psi^2 - (\kappa_w\phi_\pi)(\kappa_w\varsigma)\sigma_\gamma^2 + (\kappa_w\varsigma(1+\varphi))(\kappa_w\phi_\pi(\varsigma-1)+\varsigma)\sigma_a^2, \\
\mathbb{C}ov\left(x_t, \pi_t\right) &\propto \kappa_w(\varsigma+\varphi)\sigma_\psi^2 - (\kappa_w\phi_\pi)(\kappa_w\varsigma)\sigma_\gamma^2 + \frac{\kappa_w\varsigma^2(1+\varphi)^2}{\varsigma+\varphi}\sigma_a^2.
\end{aligned}$$

One simple set of sufficient conditions are the following:

$$\kappa_w\phi_\pi(\varsigma-1)+\varsigma \approx 0, \tag{F2}$$

$$\kappa_w\varsigma\varphi\sigma_\gamma^2 > (\varsigma+\varphi)\sigma_\psi^2, \tag{F3}$$

$$\sigma_a^2 \gg 0. \tag{F4}$$

Condition (F2) implies that the optimal capitalist signal puts negligible weight on technology shocks. Condition (F3) implies that labor disutility shocks are volatile enough so that the optimal labor supply decision is unconditionally negatively correlated with inflation. The final condition (F4) implies that, regardless of the volatility of the discount factor and labor disutility shocks, technology shocks are large enough so inflation and the output gap are unconditionally positively correlated.

Unlike the case of hand-to-mouth consumers, inattentive capitalists will always choose a signal structure which puts non-zero weight on both discount factor and labor disutility shocks. Thus, the conditions under which inattentive capitalist beliefs regarding the output gap and inflation are negatively correlated are more restrictive than those for hand-to-mouth consumers considered in the text.[29] But as this case shows, inattentive capitalists may still overweight aggregate factors which move the output gap and inflation in opposite directions.

F.3 Inattentive Firm Problem

We maintain the usual New Keynesian assumption that a firm always produces to meet demand. Thus, for a rationally inattentive firm, we assume the following decision-making structure of firms (mimicking those of inattentive households). When a firm is unable to adjust prices, we assume an "operations manager" makes labor hiring decisions passively such that firm production is consistent with demand for the firm's good (given its current price). When an inattentive firm is able to adjust prices, labor hiring decisions are instead actively chosen by the head of the firm. Given this choice of labor, the operations manager chooses the firm's price such that markets clear.[30] Thus, when making an active labor hiring choice, the firm chooses $L_t(i) = \bar{L}e^{\ell_t(i)}$ in order to maximize

$$E_t^i \sum_{k=0}^{\infty} \theta^k Q_{t,t+k}^{\mathcal{K}} D_{t+k|t}(i) - \mu I.$$

We can write the firm's relative (log) price if unable to make active decisions again until time $t+k$ as

$$\begin{aligned}\tilde{p}_{t+k|t}(i) \equiv p_t(i) - p_{t+k} &= (p_t(i) - p_t) - \pi_{t,t+k} \\ &= \frac{1}{\epsilon}(c_{t+k} - a_{t+k} - \ell_t(i)) - \pi_{t,t+k},\end{aligned}$$

[29] Note that (F2) implies $0 < \varsigma < 1$. Further, if technology shock volatility is very low, then condition (F3) will necessarily imply that the output gap and inflation are negatively correlated.

[30] We utilize this decision structure for two reasons. First, it reflects a reasonable approximation of actual firm decisions: strategic input choices are made by the head of the firm, while day-to-day decisions are delegated to managers. Second, it allows us to sidestep technical issues which arise when inattentive agents are tracking a non-stationary object (which would be the case if the firm decision-maker instead directly chose the firm's price).

where $\pi_{t,t+k}$ is the gross (log) inflation rate from t to $t+k$. Real profits are therefore

$$D_{t+k|t}(i) = (1+\tau^{\mathcal{K}})e^{(1-\epsilon)\tilde{p}_{t+k|t}(i)+c_{t+k}} - e^{-\epsilon\tilde{p}_{t+k|t}(i)+w_{t+k}+c_{t+k}-a_{t+k}} + \tau^{\mathcal{K}}e^{c_{t+k}}.$$

The firms take as given the aggregate dynamics defined above, so a log-quadratic approximation around the deterministic steady state gives

$$E_t^i \sum_{k=0}^{\infty} \theta^k Q_{t,t+k}^{\mathcal{K}} D_{t+k|t}(i) \approx -\mathbf{a}_t^\top \mathbf{B}_{aa}\mathbf{a}_t + \mathbf{a}_t^\top \mathbf{B}_{az}\mathbf{z}_t,$$

where $\mathbf{a}_t \equiv \left[\ell_t(i)\right]$, $\mathbf{B}_{aa} \equiv \frac{1}{2}\left[\frac{1}{\epsilon(1-\beta\theta)}\right]$, and

$$\mathbf{B}_{az}^\top \equiv -\frac{1}{\epsilon(1-\beta\theta)(\varsigma+\kappa_w\phi_\pi)(\varsigma+\varphi)} \begin{bmatrix} \epsilon(1-\beta\theta)(\varsigma+\varphi)-1 \\ \kappa_w\phi_\pi + \epsilon(1-\beta\theta)\varsigma \\ \kappa_w\phi_\pi(\varsigma-1)+\varsigma(1-\epsilon(1+\varphi)(1-\beta\theta)) \end{bmatrix}.$$

Note that the first-order terms drop out from the first-order conditions, and we have discarded terms independent of the choices of the firm. Further, from the decision-making structure of the firm described above, and since aggregate shocks are iid, the linear-quadratic approximation implies that for any function $f(\ell_t(i);\mathbf{z}_{t+1})$, we have $E_t^i\left[f(\ell_t(i);\mathbf{z}_{t+1})\right] \approx \hat{f}(\ell_t(i);\mathbf{0}) \equiv \bar{f} + \bar{f}_\ell \ell_t(i) + \frac{1}{2}\bar{f}_{\ell\ell}\ell_t(i)^2$, where $\hat{f}(\cdot;\cdot)$ is the quadratic approximation of f (and once again, where terms independent of choice have been dropped).

Then the firm rational inattention problem is a simple case of Prop. 1, where the state variables ψ_t, γ_t, a_t are iid. The loss matrix $\mathbf{\Omega}$ in this case has one non-zero eigenvalue, whose eigenvector is proportional to

$$\mathbf{v} = \begin{bmatrix} \epsilon(1-\beta\theta)(\varsigma+\varphi)-1 \\ \kappa_w\phi_\pi + \epsilon(1-\beta\theta)\varsigma \\ \kappa_w\phi_\pi(\varsigma-1)+\varsigma(1-\epsilon(1+\varphi)(1-\beta\theta)) \end{bmatrix}.$$

Just like the hand-to-mouth agents, inattentive firms make only one active decision (in our setting, how much labor to hire). Thus, an inattentive agent finds it optimal to collect more precise information on the optimal choice of labor demand only.

F.4 Inattentive Firm Beliefs

Since inattentive firms only observe a single-dimensional signal, the posterior survey beliefs across rationally inattentive firms will have at most one dimension. Further, the correlation of posterior survey beliefs regarding the output gap and inflation will satisfy

$$\operatorname{sign} \mathbb{C}ov\left(\hat{x}_t^i, \hat{\pi}_t^i\right) = \operatorname{sign} \mathbb{C}ov\left(x_t, \ell_t^*\right) \mathbb{C}ov\left(\pi_t, \ell_t^*\right),$$

where ℓ_t^* is the optimal labor hiring decision under full-information. Once again, unlike the case of inattentive hand-to-mouth consumers considered in the baseline model, the conditions under which simultaneously $\mathbb{C}ov\left(x_t, \pi_t\right) > 0$ but $\mathbb{C}ov\left(\hat{x}_t^i, \hat{\pi}_t^i\right) < 0$ are more more complicated. Together with the aggregate dynamics from above, we have

$$\begin{aligned}
\mathbb{C}ov\left(x_t, \ell_t^*\right) \propto\ & (1 - \theta(1 + \kappa_w \epsilon(\varphi + \varsigma))\sigma_\psi^2 + \kappa_w^2 \phi_\pi(\phi_\pi(1-\theta) - \varsigma\epsilon\theta)\sigma_\gamma^2 \\
& + \frac{1+\varphi}{\varsigma+\varphi}\varsigma\left(\kappa_w(\varsigma-1)(1-\theta) + \varsigma(1-\theta) - \kappa_w\varsigma(1+\varphi)\epsilon\theta\right)\sigma_a^2, \\
\mathbb{C}ov\left(\pi_t, \ell_t^*\right) \propto\ & \kappa_w(\varsigma+\varphi)(1 - \theta - \kappa_w(\varsigma+\varphi)\epsilon\theta)\sigma_\psi^2 - \kappa_w^2\varsigma(\phi_\pi(1-\theta) + \varsigma\epsilon\theta)\sigma_\gamma^2 \\
& + \kappa_w\varsigma\left(\kappa_w(\varsigma-1)(1-\theta) + \varsigma(1-\theta) - \kappa_w\varsigma(1+\varphi)\epsilon\theta\right)\sigma_a^2, \\
\mathbb{C}ov\left(x_t, \pi_t\right) \propto\ & \kappa_w(\varsigma+\varphi)\sigma_\psi^2 - (\kappa_w\phi_\pi)(\kappa_w\varsigma)\sigma_\gamma^2 + \frac{\kappa_w\varsigma^2(1+\varphi)^2}{\varsigma+\varphi}\sigma_a^2.
\end{aligned}$$

One set of simple sufficient conditions are the following:

$$\varsigma \approx 1, \tag{F5}$$

$$\epsilon \approx \frac{1}{(1+\varphi)(1-\beta\theta)}. \tag{F6}$$

Conditions (F5) and (F6) together imply that the optimal labor choice is a function of γ_t shocks only, and so the firm optimal signal puts no weight on discount factor ψ_t or technology shocks a_t. Thus, regardless of the volatility of labor disutility shocks σ_γ^2, firm posterior beliefs will feature negative correlation between inflation and the output gap (mimicking our findings regarding hand-to-mouth households in Corollary 3.1).

However, depending on the values of φ, β, and θ, there may be no choice of demand elasticity $\epsilon > 1$ which satisfies condition (F6). Instead of (F6), the following parameter restriction is also sufficient:

$$\kappa_w\phi_\pi\sigma_\gamma^2 \lessapprox (1+\varphi)(\sigma_\psi^2 + \sigma_a^2). \tag{F7}$$

Conditions (F5) and (F7) together imply that inflation and the output gap are unconditionally positively correlated. However, this correlation is not too large relative to the total volatility of inflation, and so optimal labor demand is unconditionally negatively correlated with inflation and positively correlated with the output gap. In this case, unlike the case of hand-to-mouth consumers, inattentive firms will choose a signal structure which puts non-zero weight on both discount factor and labor disutility shocks.

Thus, the conditions under which inattentive firm beliefs regarding the output gap and inflation are negative correlated are slightly more restrictive than those for hand-to-mouth consumers considered in the text. But as these cases show, inattentive firms may still overweight aggregate factors which move the output gap and inflation in opposite directions.

Appendix G Additional Model Output

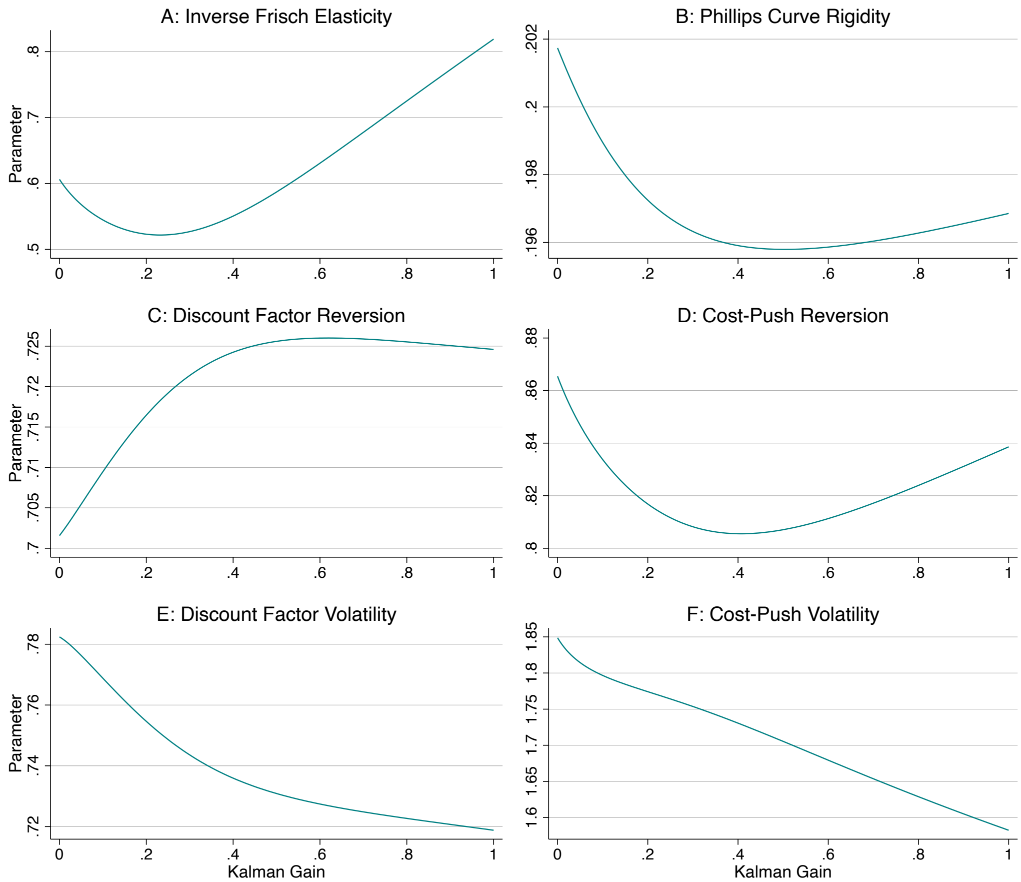

Figure G1: Estimated Parameters: Varying Information Frictions

Notes: parameter estimates of the model as we vary the Kalman gain parameter $K \in (0, 1)$. For each point on the x-axis, we re-estimate the model targeting the same set of moments in Table 2 (besides the correlation of inflation beliefs and inflation). Each panel corresponds to the different parameters we calibrate.

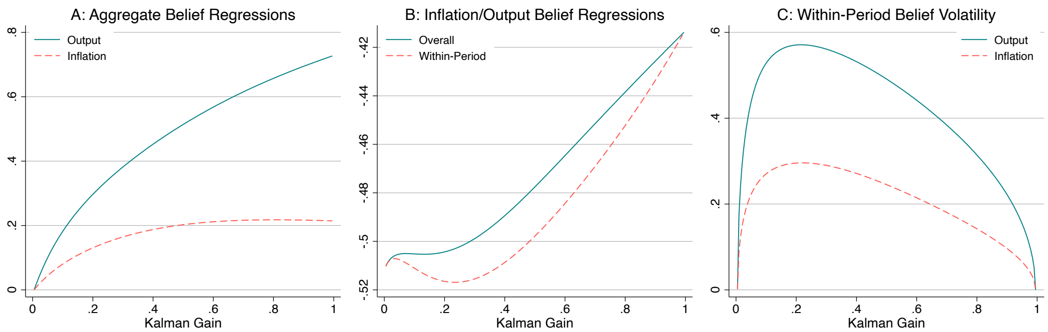

Figure G2: Beliefs as a Function of Information Costs

Notes: model-implied moments as a function of information costs K. Panel A reports model-implied regression coefficients of $\hat{y}_t^j$ on y_t (solid line) or $\hat{\pi}_t^j$ on π_t (dashed line). Panel B reports model-implied regression coefficients of $\hat{\pi}_t^j$ on $\hat{y}_t^j$; the solid line reports unconditional coefficients, while the dashed line is cross-sectional (across $j \in [0, \lambda]$). Panel C reports the cross-sectional volatility of beliefs regarding $\hat{y}_t^j$ (solid line) and $\hat{\pi}_t^j$ (dashed line).

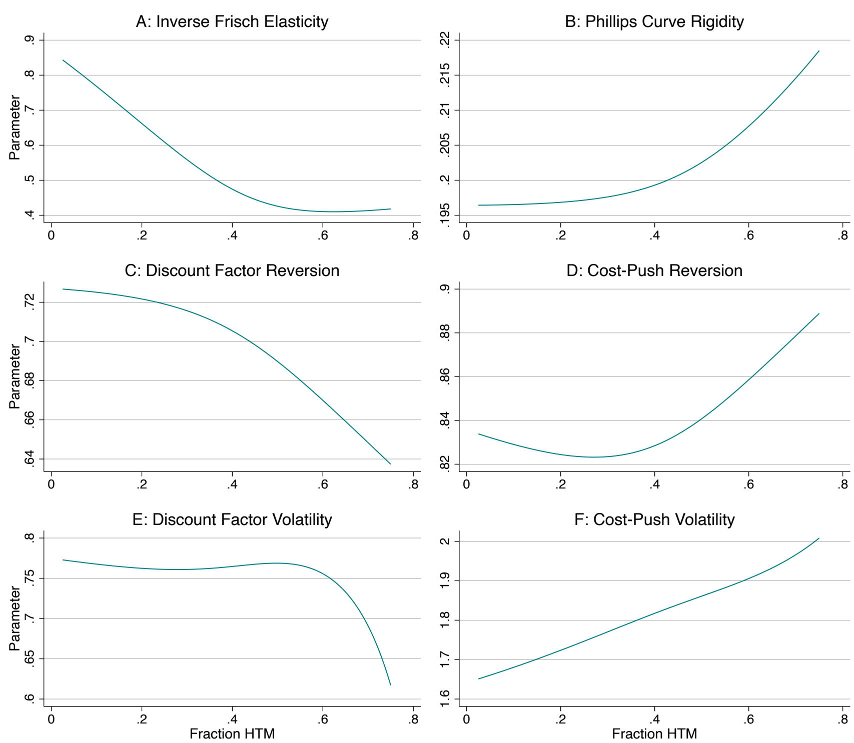

Figure G3: Estimated Parameters: Varying Hand-to-Mouth Fraction

Notes: parameter estimates of the model as we vary the fraction of $\mathcal{H}$ households $\lambda \in (0, 1)$. For each point on the x-axis, we re-estimate the model targeting the same set of moments in Table 2. Each panel corresponds to the different parameters we calibrate.

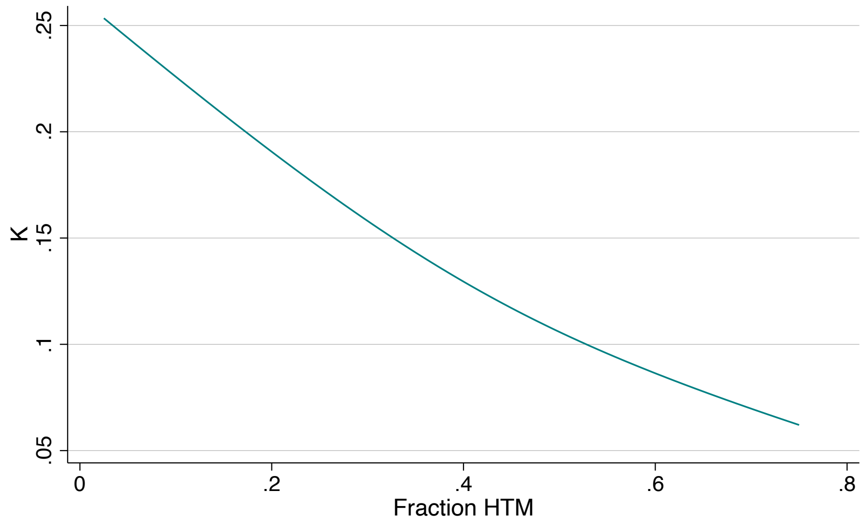

Figure G4: Parameters Information Frictions: Varying Hand-to-Mouth Fraction

Notes: Kalman gain K estimates of the model as we vary the fraction of $\mathcal{H}$ households $\lambda \in (0, 1)$. For each point on the x-axis, we re-estimate the model targeting the same set of moments in Table 2.

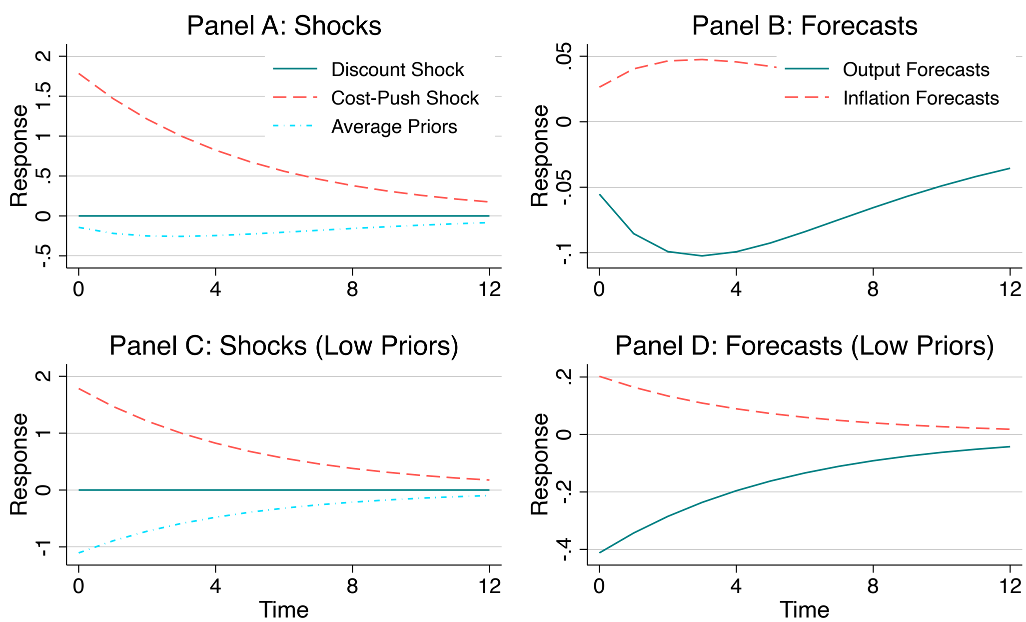

Figure G5: Response to Supply Shock: State Variables and 1-Year Ahead Forecasts

Notes: IRFs of the model state variables v_t, γ_t, m_t and the one-year-ahead output and inflation posterior beliefs $\hat{y}^j_{t+4}, \hat{\pi}^j_{t+4}$ following the supply shock considered in Figure 5.

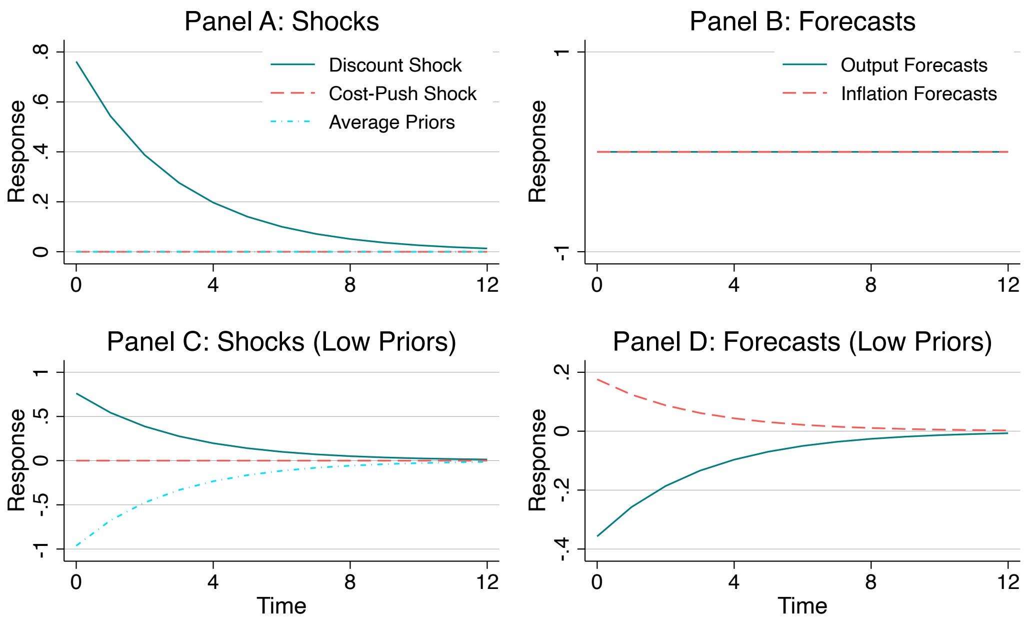

Figure G6: Response to Demand Shock: State Variables

Notes: IRFs of the model state variables v_t, γ_t, m_t and the one-year-ahead output and inflation posterior beliefs $\hat{y}^j_{t+4}, \hat{\pi}^j_{t+4}$ following the demand shock considered in Figure 6.